

1. Using this Guide

The Display 3-Dimensional workstation application (D3D) allows users to view real-time meteorological data in a three-dimensional interactive display. It is aimed at providing an advanced operational workstation to operational forecasters. The D3D capability is experimental and is designed to supplement traditional 2D display capabilities available to forecasters. Display 2-D (D2D) and D3D share a common database.

1.1 Overview of D3D

Visualization transforms numeric data into a visual form that allows users to conceptualize and understand the information. There are two basic ways to change data into colored visual information: the image method where data points are translated into pixels, and the geometry method where data is converted into descriptions of three dimensional geometric objects.

D3D offers several visualization techniques to display atmospheric data with graphical cues and markers to aid in analysis. It is important to note that the value added by visualization of atmospheric data is related to the resolution of the data. As temporal and spacial resolution of the data sets increase, so does the value of the ability to more quickly make observations in the data sets that have three recursive phases: detection, identification, and measurement and analysis.

Development of the software is being done on a PC/Linux workstation. We are currently using software rendering for portability. At the core of the D3D capability is the Vis5D software developed at the University of Wisconsin.

1.2 Intended Audience and Assumed User Skills

This Guide is intended for use by hydrometeorological forecasters who use the AWIPS Workstation environment. Users are assumed to be familiar with D2D, and as such should have a basic understanding of, and experience with, using a mouse to navigate a graphical user interface.

Many of the functions and operations should be familiar from D2D. These include such operations as opening, resizing, moving, and closing windows, and selecting items from menus. However, the specific differences between how the mouse is used in D3D versus D2D are highlighted.

1.3 Organization of the Guide

This Guide is structured to follow the organization of the D2D User's Guide...

(http://www.fsl.noaa.gov/~osborn/D2DUG_ToCFigs.html)

as much as possible. Section 2 presents details of the D3D layout and the specifics of 3D visualization, while Section 3 offers step-by-step instructional modules.

1.4 Additional Vis5D Information

Vis5D version 1.0 was written by Bill Hibbard and Dave Santek of the University of Wisconsin Space Science and Engineering Center, supported by the NASA Marshall Space Flight Center, and by Marie-Francoise Voidrot-Martinez of the French Meteorology Office. Later version enhancements were written by Bill Hibbard, Brian Paul, and Andre Battaiola. Dave Kamins and Jeff Vroom of Stellar Computer, Inc. provided substantial help and advice in using the Stellar software libraries. Simon Baas and Hans de Jong of the Netherlands ported Vis5D to HP workstations. Pratih Shah of Kubota Inc. ported Vis5D to the Kubota Alpha/Denali workstation. Mike Stroyan of Hewlett-Packard added PEX support. Johan Kellum added the dynamic sounding feature in Version 4.3, and wrote and maintains Vis5D Version 5.0 at the University of Wisconsin Space Science and Engineering Center. Vis5D was offered under the terms of the GNU General Public License.

2. Getting to Know D3D

The three-dimensional (3D) workstation application, D3D, allows you to display and manipulate graphic and image products, and work with gridded model data. Subsection 2.1, "First Things to Know About D3D," provides the information needed to start, set up, and exit the D3D workspace and gives a brief introduction to D3D. Some topics covered in Subsection 2.1 are addressed in more detail in later subsections. Subsection 2.2, "Working with Graphic and Image Products," contains information and details that illustrate basic display capabilities.

The Volume Browser, which provides access to numerical models and other gridded data sources, is covered in Subsection 2.3. This subsection is very detailed in describing the many rendering techniques available, as well as describing the general features of the Volume Browser. Subsection 2.4 gives other 3D rendering techniques.

2.1 First Things to Know About D3D

Figure 1 shows the hardware components of the AWIPS Workstation.



Figure 1. The AWIPS Workstation.

The input devices for the graphics monitors are a keyboard and a single three-button mouse. Mouse Buttons are designated by number, as shown in Figure 2, which also gives the functions and user interface locations of each Mouse Button action.

D3D Viewing Modes and Product Label Mouse Button Behavior

Viewing Mode	Button	Function
Normal	B1	Rotate
	B2	Zoom In/Out
	B3	Pan
Slice	B1	Rotate
	B2	Zoom In/Out
	B3	Move Slice Location
Probe	B1	Rotate
	B2	Zoom In/Out
	B3	Move Cursor Location
Sounding	B1	Rotate
	B2	Zoom In/Out
	B3	Move Cursor Location
Trajectory	B1	Rotate
	B2	Make Trajectory
	B3	Move Cursor Location
Clipping	B1	Rotate
	B2	Toggle Slice
	B3	Move Slice Location
Label	B1	Make Label
	B2	Move Label Location
	B3	Delete Label
Product Label	Button	Function
Anywhere on Product Label (<i>Normal or Slice Mode only</i>)	B1	Toggles Object
	B3	Toggles All Product Labels
Label (<i>Normal or Slice Mode only</i>)	SHIFT+B1	Links Cross-Sections
	SHIFT+B3	Unlinks Cross-Sections



Figure 2. Right-Handed Mouse Button and Button Functions.

Most mouse actions are invoked with Mouse Button 1. For a right-handed mouse, Button 1 is on the left. All references in this Guide to the use of a Mouse Button (e.g. click on the selector...) refer to Mouse Button 1 unless otherwise noted.

The actions associated with each Mouse Button are described in more detail in “Viewing Modes,” found in Subsection 2.3, “The Volume Browser.”

2.1.1 Input Devices

There are two devices that enable you to input information into the D3D graphical interface regarding actions you want to invoke: a Three-Button Mouse and a Keyboard. Currently, there are no Accelerator Keys.

2.1.1.1 Mouse (Pointing Device)

The Three-Button Mouse (refer to Figure 2) is D3D’s primary input device. Each button performs a number of different actions depending on where the mouse pointer is located and on the selected Viewing Mode. Understanding mouse operations may be the most challenging aspect to learning the system.

The mouse pointer is the graphical arrow that appears in the D3D workspace. It indicates the mouse’s current position. In all the following sections of this User’s Guide, it is referred to as simply the “pointer.”

Mouse Button 1 is the primary activator button. This is the button you use to open and close menus and to make most menu selections. Most of the Mouse actions described in Figure 2 are related to features that are covered in detail in upcoming subsections.

2.1.1.2 Keyboard

D3D uses a standard workstation keyboard.

2.1.2 Start Up and Exit

2.1.2.1 Login

If your system has a screen saver, move the mouse to display the login prompt. The login name and password are assigned by your system administrator and may therefore vary from machine to machine.

2.1.2.2 Start Application

To start D3D, execute the Bourne shell `d3d_demo/app/app-d3d`, located in the D3D directory. Its best to create a launcher icon to that allows the use to click an icon to start the application.

Once the Start D3D splash window (see Figure 3) is replaced by the full-screen D3D application and the D3D Volume Browser appears, the system is ready to load data.

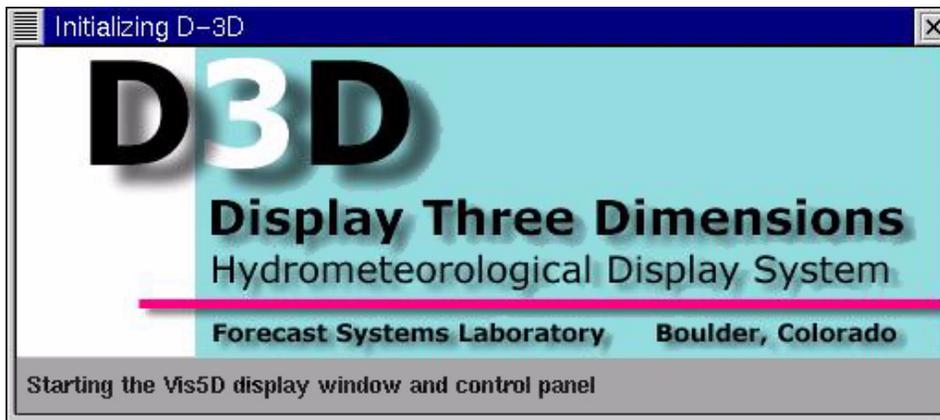


Figure 3. Start D3D.

2.1.2.3 Exit

Exit shuts down the D3D workspace application. Find Exit under the File option on the Menu Bar (see Subsection 2.1.6, “Menu Bar”). A dialog box appears in the middle of the display screen when you choose this option, asking you to confirm that you really want to exit.

2.1.3 Layout of the D3D Graphics Display

From the system’s point of view, the entire D3D interface is a window. As such, it can be moved, minimized (iconified), restored, etc., in the same way as any other window displayed by the system.

The D3D application is partitioned into three separate windows:

1. - a set of Menu Bars at the top of the screen;
2. - a Large Display Pane;
3. - the D3D Volume Browser (Figure 4).

The Graphics Display Window is a standard X-window and has the basic X-window controls in its title bar, as do all windows in the application.

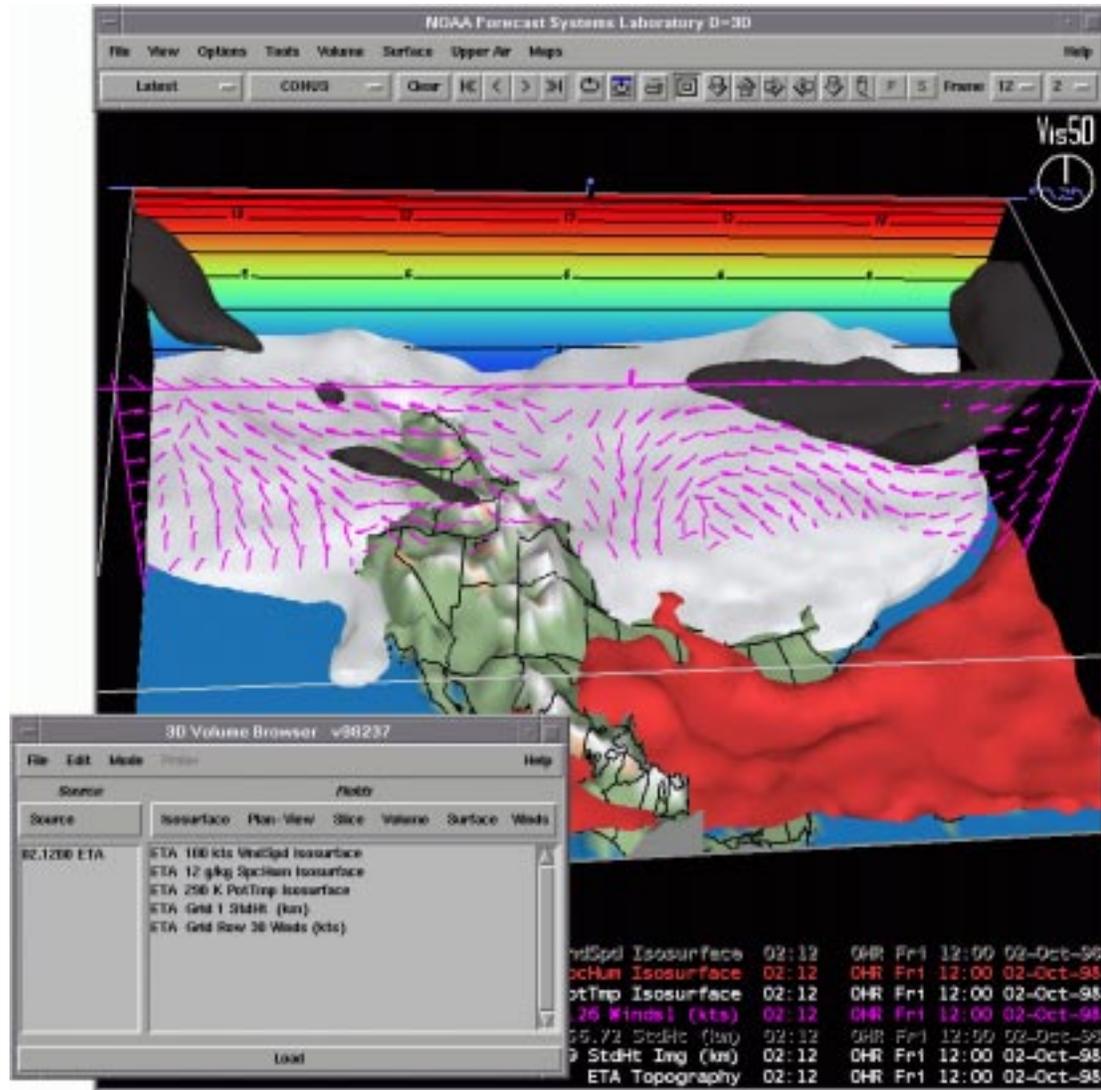


Figure 4. D3D - Vis5D Application Windows. The image shows the 0 hour ETA model forecast valid for 1200 UTC 2 Oct 1998 as viewed from the south. Displayed is a 100 kt wind speed isosurface colored gray, a vertical east-west cross section of wind bars centered through Laramie, Wyoming, a 290 K potential temperature isosurface colored white, a 12.0 g/kg specific humidity isosurface colored red, and a contoured and colored vertical cross section displaying heights.

2.1.4 Windows, Tooltips, Menus, and Dialog Boxes in D3D

The behavior of windows, tooltips, menus, and dialog boxes in D3D are identical to the behavior found in D2D. Refer to the *AWIPS D2D User's Guide* Subsection 2.1.4, “Windows, Tooltips, Menus, and Dialog Boxes in D2D,” for detailed information.

2.1.5 Other D3D Operational Information

This subsection contains additional information on the operational behavior of D3D.

2.1.5.1 Auto Update

In contrast to D2D, products for D3D are not automatically loaded as new versions of currently-loaded products become available to the system. They need to be manually loaded for display. Auto Update is not currently implemented.

2.1.5.2 Time Matching

Again in contrast to D2D, you cannot add overlays from other models or subsequent model runs to a displayed product. Thus, time matching of products is restricted to the selected model.

2.1.5.3 General Status Messages

When data are missing or incomplete, or there are other problems with the workstation, the system sends status messages, which are displayed in the Status Window. There are three priority levels: Routine, Significant, and Urgent. Routine messages appear in the General Status Area of the Status Bar. A list of these messages are appended to the General Status Dialog Box. Both are shown in Figure 5.

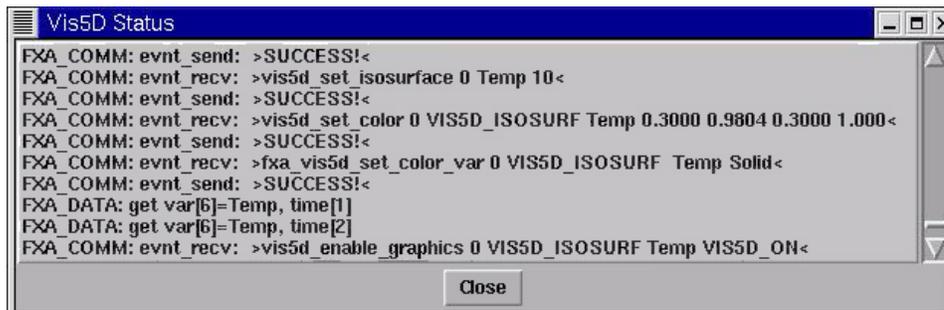


Figure 5. The D3D Status Dialog Box.

This General Status Dialog Box is opened by clicking on "Status" from the Help Pull-Down Menu found on the Menu Bar. Urgent messages appear in a Red Banner Announcement Dialog Box, shown in Figure 6.



Figure 6. The D3D Announcement Dialog Box.

This dialog box is closed by clicking anywhere inside it.

2.1.5.4 System Clock

A workstation's system clock usually appears along the bottom of the Main Display. Additionally, there is a Vis5D model clock with hands in the

upper right corner of the Main Display. This refers to model time.

2.1.5.5 Clock and Watch Face Indicators

The D3D Pointer changes to a watch face to let you know the system is processing your request. When you see the watch face the system is busy, but it can still respond to your requests. For example, you can select a product and press the Clear Button to preempt the loading process.

2.1.6 The Menu Bar

The following subsections contain descriptions of each menu button displayed along the Menu Bar, moving from left to right. The Menu Bar consists of menu buttons which open pull-down menus. Keep in mind that some menu options require more detailed explanation, which are provided in subsequent subsections of this User's Guide. Refer to Figure 7.



Figure 7. D3D Menu Bar.

NOTE

*Bundles and scripts accessed through some of the Menu Bar pull-down menus can automatically load products, but only **after** a model is first selected via the Volume Browser. Refer to Subsection 2.3, "The Volume Browser," for more information.*

2.1.6.1 File

Refer to Figure 8 for a display of this menu.

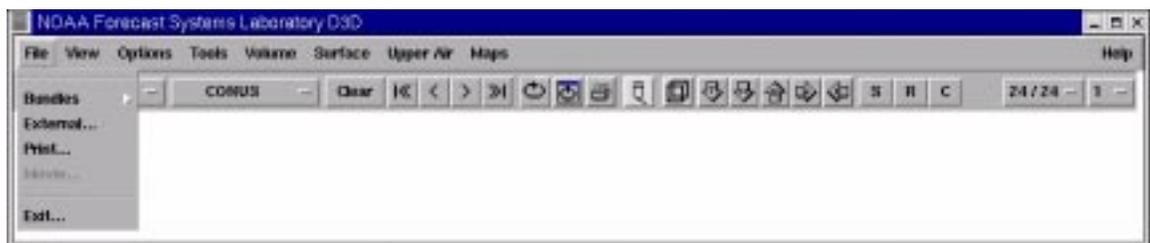


Figure 8. The File Menu.

•Bundles

Bundles are user-generated lists of graphics and/or image products, which let you define, customize, and save a sequence of products. Bundles provide a convenient way to display commonly used products, or products that are needed for a certain weather scenario. If, for example, you display 285 K Potential Temperature colored by a customized Height Color Table,

you can save this grouping of products, known as a bundle, in a file for future use.

Bundles contain not only all the products you overlaid onto the display, but also the display parameters, such as color tables, graphics control settings, isosurface values, etc., and particulars such as zoom factor and viewing perspective. You can have any number of products in a bundle and then label your file to reflect its contents or with your own name.

•Cascading Menu

From the File Pull-Down Menu in the Menu Bar, the Bundles Cascading Menu (Figure 9) can be opened.



Figure 9. The Bundles Cascading Menu.

New...

The New option opens a New (Empty) Bundle Dialog Box, shown in Figure 10, from the Bundles Cascading Menu.

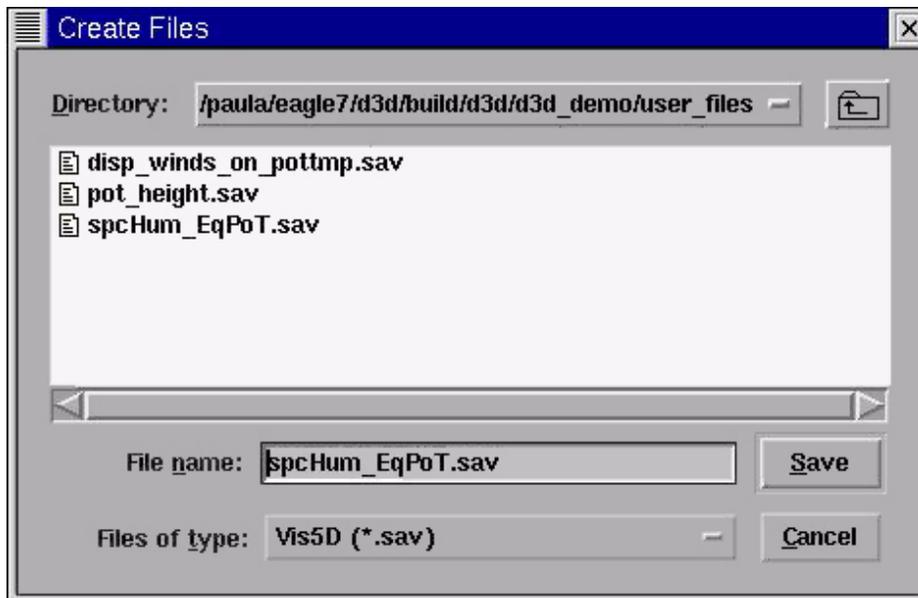


Figure 10. The Bundle Dialog Box.

When first opened, this dialog box is empty, unsaved, and untitled. The buttons in the Bundle Dialog Box are used to save a bundle to a file. By convention use “.sav” as the file extension.

Open...

This option opens the Open Bundle Dialog Box from the Bundles Cascading Menu. This dialog box provides a list of files of currently available bundles.

To open an existing bundle, highlight it and click the OK Button at the upper right of the dialog box, or you can double click on the bundle name. You can also type the bundle name on the line provided in this dialog box.

Delete...

This option is not yet implemented.

•Print...

This option sends everything currently visible in the Large Display Pane to the default printer. Refer to Figure 11.

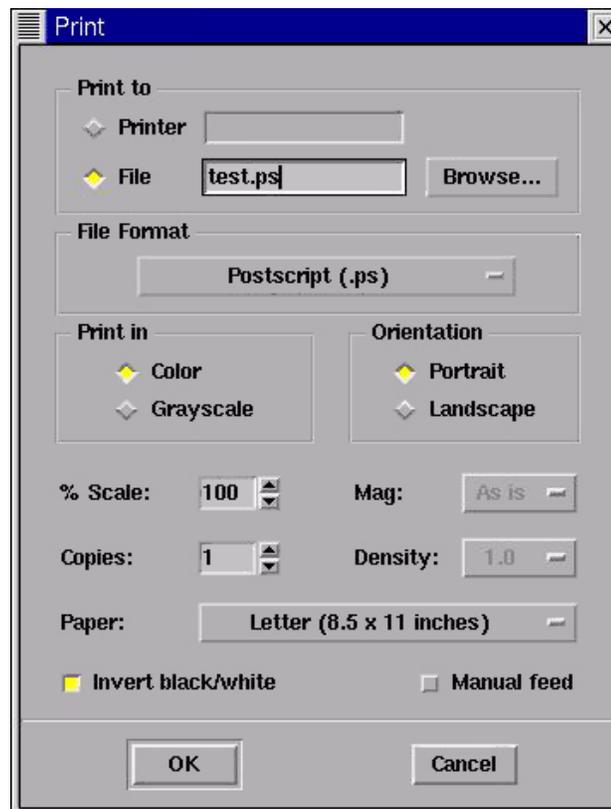


Figure 11. The Print Dialog Box.

These printing options should be familiar to most computer users. The gray labeled options are not applicable.

•Movie...(Disabled)

This option sends a time series of everything currently in the Large Display Pane to the disk. The images are converted to an Mpeg movie or a series of GIF images. Refer to Figure 12.

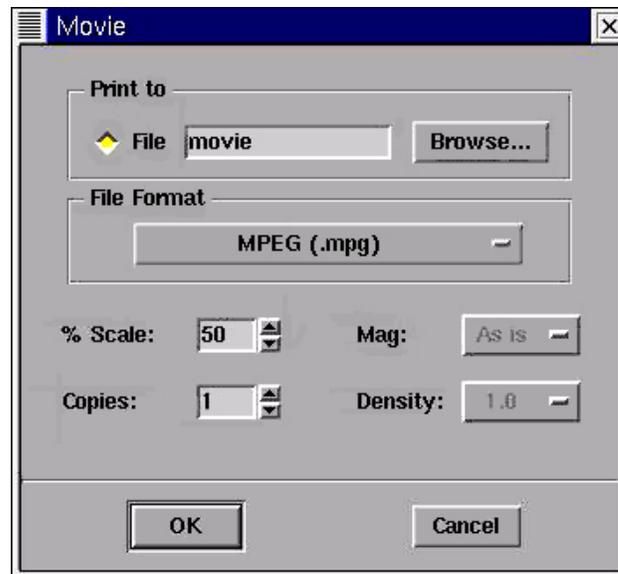


Figure 12. The Movie Dialog Box.

These options include a filename entry box and a pull-down menu allowing you to select between an Mpeg movie or a time-series of GIF images.

•Exit

Shuts down the D3D workspace application. A dialog box appears in the middle of the display screen when you chose this option, asking you to confirm that you really want to exit.

2.1.6.2 View

The View Pull-Down Menu, shown in Figure 13, contains options that control the display layout, views, and product animation. Most, but not all, options have corresponding icon buttons in the second row of menu options called the Toolbar.

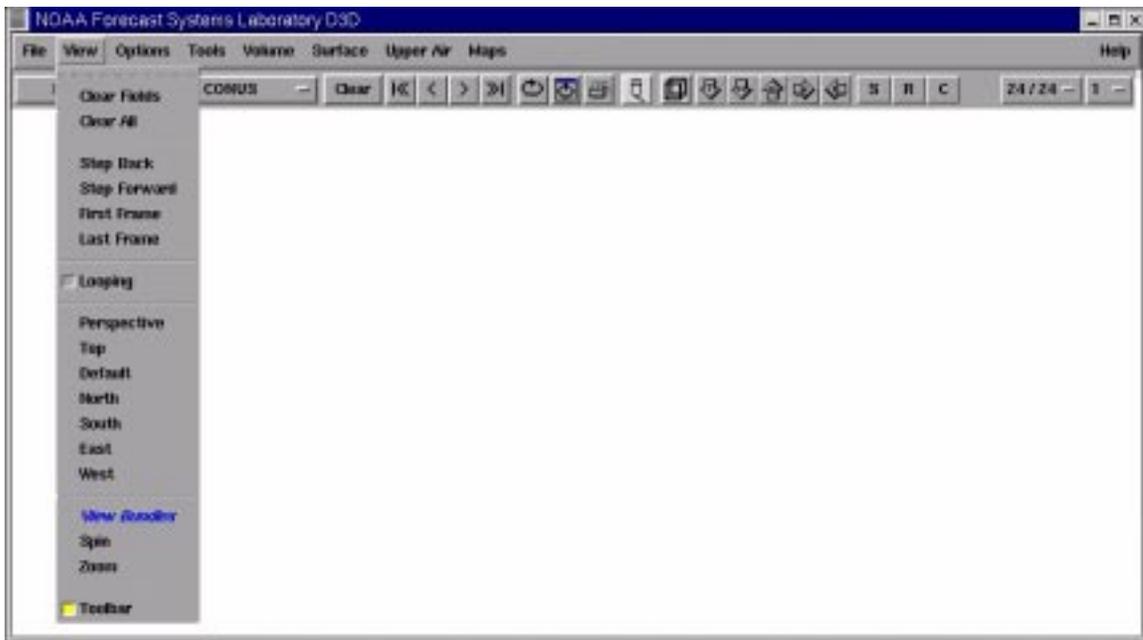


Figure 13. The View Menu.

•Clear Fields

This option clears all products in the Large Display Pane except for the map background and topography. The selected model remains loaded in memory so new products can be loaded easily. You can also use the Clear Button in the Toolbar.

•Clear Model

This option clears the Large Display Pane. The map background remains.

•Step Back

This menu option reverses the displayed data by one frame. You can also use the “<” Icon Button in the Toolbar.

•Step Forward

This menu option advances the displayed data by one frame. You can also use the “>” Icon Button in the Toolbar.

•First Frame

This option displays the first frame of available data. You can also use the “|<<” Icon Button in the Toolbar.

•Last Frame

This option displays the last frame of available data. You can also use the “>>” Icon Button in the Toolbar.

•Looping

This check button enables/disables animation. You can also use the Loop Icon Button in the Toolbar.

•Perspective

This option toggles between perspective and orthogonal viewing projections. Perspective viewing adds 3D Display depth, while orthogonal does not. You can also use the Perspective Button in the Toolbar.

•Top

This option resets the Large Display Pane to the default top view without changing the zoom factor. You can also use the **T** Directional Button in the Toolbar.

•Default

This option resets the Large Display Pane to the default top view and normalizes the zoom factor back to a value of 1.0.

•North

This option sets the Large Display Pane to a north position looking south. You can also use the **N** Directional Button in the Toolbar.

•South

This option sets the Large Display Pane to a south position looking north. You can also use the **S** Directional Button in the Toolbar.

•East

This option sets the Large Display Pane to an east position looking west. You can also use the **E** Directional Button in the Toolbar.

•West

This option sets the Large Display Pane to a west position looking east. You can also use the **W** Directional Button in the Toolbar.

•Spin

This activates a script that spins the 3D Box in the Display Pane demon-

strating rotation capabilities. Currently the script cannot be interrupted and must run to completion (one revolution).

•Zoom

This activates a script that zooms the 3D Box in the display demonstrating scaling capabilities. Currently the script cannot be interrupted and must run to completion.

•Toolbar

This check button option enables/disables the Toolbar, the second row of options along the top of the display. If you need more viewing space in the Display Panes, you can hide the Toolbar. All of the controls in the Toolbar are redundantly placed in the View and Options Pull-Down Menus, so that you can perform all Toolbar actions without the Toolbar. Refer to Subsection 2.1.7, “The Toolbar,” for further information.

2.1.6.3 Options

The Options Pull-Down Menu is shown in Figure 14.



Figure 14. The Options Menu.

It contains popup menus that allow you to select the property options listed as follows.

•Loop Properties

This option allows you to set the looping properties. You can also use the Loop Properties Button in the Toolbar. Refer to Subsection 2.1.7, “The Toolbar,” for further information.

•Display Options

These menu options allow you to customize various display properties and preferences in the Large Display Pane, such as the visibility of the bounding box and legends, for example, and selecting the wind glyph type.

Box

On by default, this check box toggles the 3D Bounding Box.

Depth Cue

On by default, Depth Cue causes lines to "fade away" as they get more distant from the viewing position, enhancing the illusion of 3D depth in the Large Display Pane. No depth cues are noticeable, however, when the Large Display Pane's background is colored white.

Grid Numbers

Off by default, this check box toggles the display of horizontal and vertical tags between grid numbers and latitude/longitude and elevation values. This applies to cross sections and cursor positions.

Legends

On by default, this check box toggles the display of color bar legends in the Large Display Pane. Color legends are valid for slices, volume visualization, and isosurfaces when colored by a second field.

Reverse B/W

Normally, the Large Display Pane's 3D Box, labels, and clock are drawn in white on a black background. This option reverses that and draws the box, labels, and clock colored black on a white background. This is useful for making paper printouts.

Alpha Transparency

Transparency controls the degree to which you can see through the front of an object, allowing you to see the back of the object and other objects behind it. Alpha blended transparency (on by default) offers a smooth transparent surface (If supported by hardware graphics). Mesh transparency has a dithered appearance and is sometimes referred to as screen door transparency. It is difficult to present multiple levels of transparency in a scene due to inherent limitations on PEX platforms.

Wind Arrows

The wind glyphs are displayed as wind barbs by default. Select this check box to change the glyph representation to wind arrows/vectors.

2.1.6.4 Tools

The Tools Pull-Down Menu is shown in Figure 15.

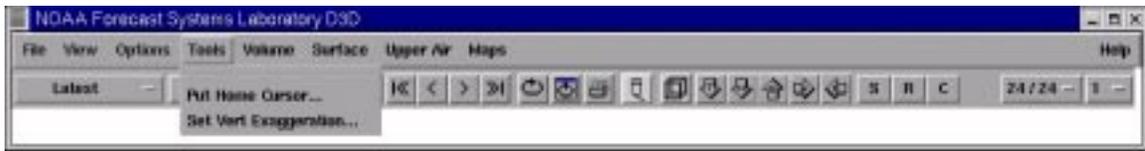


Figure 15. The Tools Menu.

It contains popup menus used to locate the 3D Cursor and set the vertical scaling.

•Put Home Cursor...

Horizontal Location

The Put Home Cursor Dialog Box, shown in Figure 16, has a station list containing a selectable list of METAR and RAOB stations. Click on a Station name with the pointer to instantly move the Probe, Sounding, or Trajectory 3D Cursor to a station location.

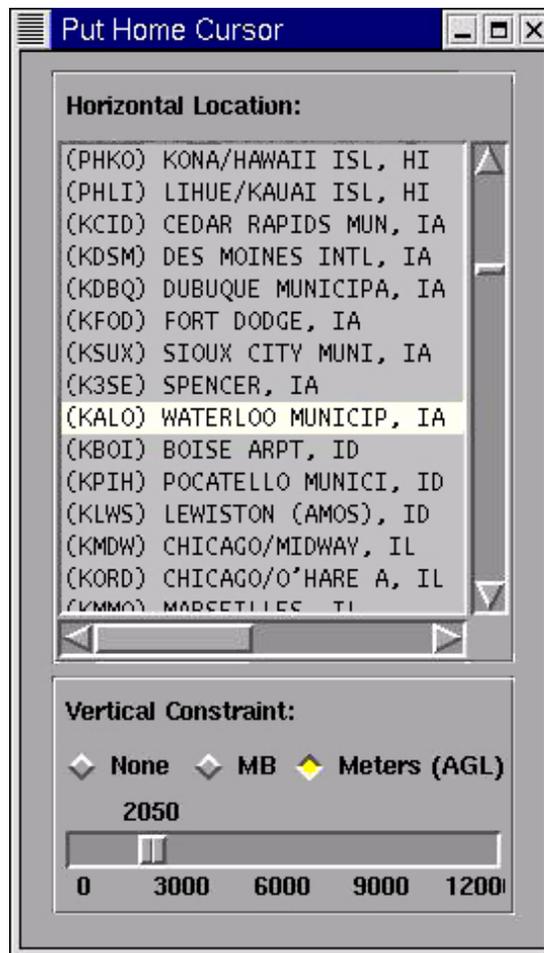


Figure 16. The Put Home Cursor Dialog Box.

NOTE

The cursor must be in Probe, Sounding, or Trajectory Viewing modes for the Put Home Cursor Dialog Box to be active, otherwise labels appear gray and no action is taken.

Vertical Constraint

Frequently the gross resolution of model generated topography causes both the Probe and Trajectory Cursors to appear below ground. Radio buttons, allowing you to dynamically set the 3D Cursor to a fixed pressure level, or fixed height above ground.

•Set Vertical Scale...

This option allows you to dynamically set the vertical scale of the model. A default value is available in the entry box when the Set Vertical Scale Dialog Box is first opened, as well as when **Default** is selected. Entering a value larger than the default value causes the model’s vertical scale to increase. Likewise, entering a value smaller than the default value causes the model’s vertical scale to decrease.

2.1.6.5 Volume

Refer to Figure 17 for a display of this menu.

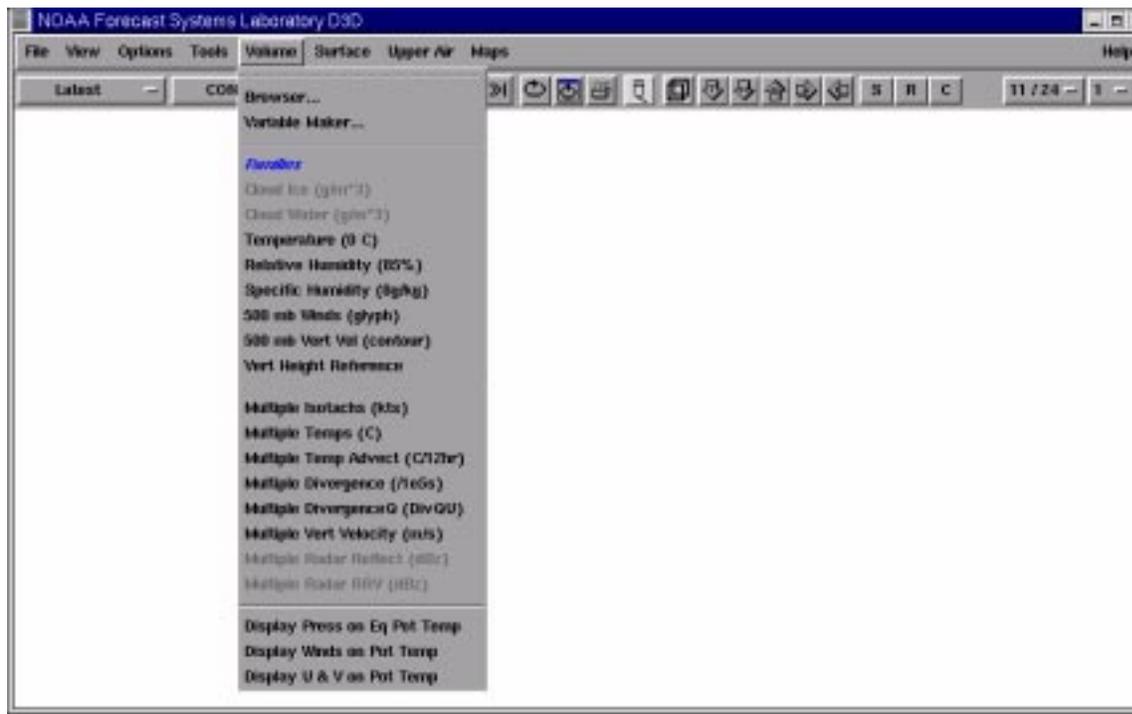


Figure 17. The Volume Menu.

From this menu you can open the Volume Browser (refer to Subsection 2.3, “The Volume Browser”), which provides access to gridded model data. You can also open the Variable Maker (refer to Subsection 5.1, “Variable Maker”), which enables you to create and generate your own fields on demand.

From this menu you can also select Families. These scripts, similar to D2D Families, are preselected groups of data products which can be displayed with a single mouse click over the script name in this menu. Once a model is selected (from the Volume Browser's Source Pull-Down Menu) the available menu items are shown in black. Unavailable items appear in gray.

2.1.6.6 Surface

The Surface Pull-Down Menu, shown in Figure 18, contains a list of surface scripts.

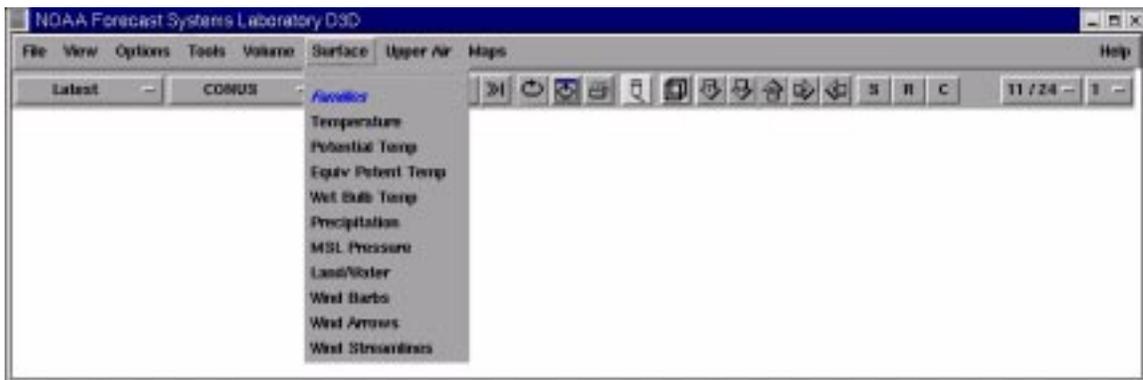


Figure 18. The Surface Menu.

•Families

You can select these scripts to load surface data. These Script Products, similar to D2D Families, are preselected groups of data products which can be displayed with a single mouse click over the script name in this menu. Wind barbs and arrow are mutually exclusive glyphs.

2.1.6.7 Upper Air

The Upper Air Pull-Down Menu is shown in Figure 19.



Figure 19. The Upper Air Menu.

•Trajectory Column

If Trajectory is selected as the Viewing Mode, you can then select the *Trajectory Column* from this menu to produce a column of trajectory ribbons at the 3D Cursor location. This applies to trajectory "set1" only.

2.1.6.8 Maps

Refer to Figure 20 for a display of this menu and Figure 21 for a display of the slider for movable map option.

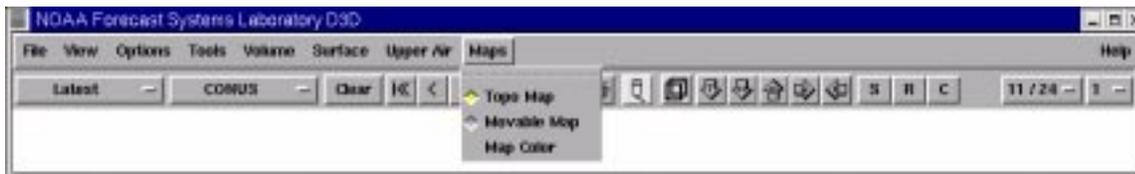


Figure 20. The Map Menu.

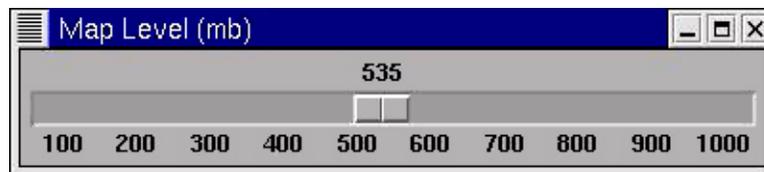


Figure 21. Slider for Movable Map Option.

The Map Pull-Down Menu has two background map options in addition to a color editor. The choice of **Topo Map** fits the map to the topography surface. The choice of **Moveable Map** pops up a slider allowing you to interactively move a flat horizontal map to any pressure level.

It is sometimes desirable to display a map at the 100 mb level, particularly when another product obscures the surface topography and map. Another reason to use the moveable map is to display a map at the same level as a horizontal cross section. This creates a label that appears in the display window, allowing the map to be linked with other cross sections.

Select the Map Color Check Button to pop up a Colors Editor Dialog Box with three sliders labeled red, green, and blue, and a color wheel. To change the map color, just move the sliders.

2.1.6.9 Help

This pull-down menu, shown in Figure 22, provides on-line assistance and information about D3D.

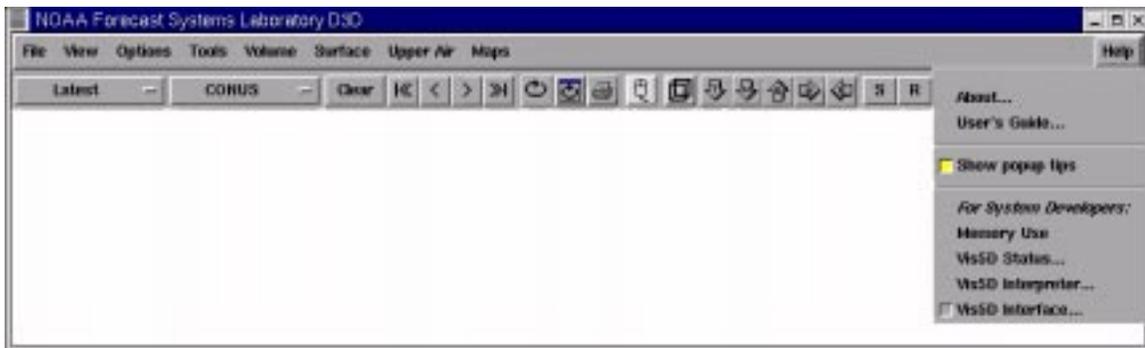


Figure 22. The Help Menu.

- About...

Provides the build and release dates of the D3D application software.

- Users Guide...

Contents connects you, via Netscape, to the Table of Contents of this *D3D On-Line User's Guide*.

- Show Popup Tips

Provides a check button that enables/disables the Tooltips.

- For System Developers

Memory Use

Memory Use compares the memory requested by D3D with the free system memory. Refer to the *D3D Installation Guide* for more information.

Vis5D Status...

Status allows you to pop-up a monitor window. The messages contained in the Status Window (discussed in Subsection 2.1.5, "Other D3D Operational Information") may include announcements from the D3D communication software. Warning messages that appear in the Status Window are usually related to data access. Refer back to Figure 5.

Vis5D Interpreter

The Vis5D Interpreter is an entry box for direct communication with Vis5D. This option is used almost exclusively by D3D system developers. Refer to Figure 23.

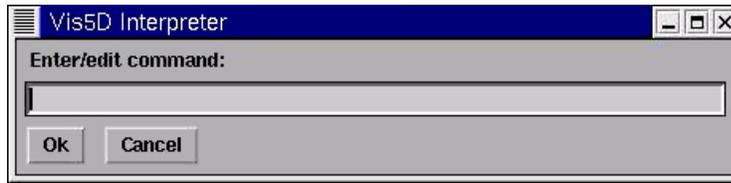


Figure 23. Vis5D Interpreter.

Vis5D Interface

Provides access to the original Vis5D User Interface control panel. This option is used almost exclusively by D3D system developers.

2.1.7 The Toolbar

The following subsections contain brief descriptions of each menu and icon button displayed along the second row of the menu options, called the Toolbar, from left to right on your workstation screen. Refer to Figure 24.

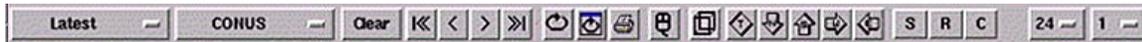


Figure 24. D3D Toolbar.

Certain icon buttons in the Toolbar are check buttons. These icon buttons turn a light gray color when they are in the “on” position. Helpful labels, or Tooltips, appear as you slowly move the pointer over these icons.

2.1.7.1 Load Modes

Load Modes provide different ways to display model or real-time data by manipulating previous model runs and inventories of data sets. Use this pull-down menu to select a mode *before* loading a model from the Volume Browser. A brief description of each Load Mode follows.



- Latest Run

This Load Mode displays forecast data only from the latest model run.

- Previous Run

This Load Mode displays the previous model run, but does not fill empty frames with older data.

•Inventory

Selecting a model from the Volume Browser's Source Pull-Down Menu when the Load Mode is set to Inventory pops up a window showing you a complete inventory listing, from which you can select the model run you want.

•Analysis Loop

This Load Mode loads a sequence of model analyses, but no forecasts.

•dProg/dt

This Load Mode selects forecasts from different model runs which all have the same valid times. This Load Mode is available only when there are no other products loaded in the Large Display Pane.

2.1.7.2 Scale



From this menu you can choose one of four scales, Northern Hemisphere, North American, CONUS, and WFO. These scales are identical to those used in D2D.

When D3D is first started up, the CONUS Scale is displayed in the Large Display Pane. However, you can use the Scale Option Menu to choose any scale. Once data have been loaded, changing the scale does not affect the Large Display Pane until you display a new product. It does affect what products are available in the menus. In other words, product availability is scale-dependent.

2.1.7.3 Clear



This button, which turns red when the pointer is over it, clears the Large Display Pane except for the map background and topography. *The selected model remains loaded in memory so new products can be loaded easily.* The entire model is cleared from the display when Clear is selected with Mouse Button 2.

2.1.7.4 Stepping



This set of four menu buttons allows you to Step Backward (<) or Step Forward (>) through multiple frames of data, one frame at a time, or to move immediately to the First (|<<) or Last (>>|) frame in the loop.

2.1.7.5 Loop



This icon button toggles looping in the Large Display Pane. Looping is on when the icon button is a lighter gray color.

2.1.7.6 Loop Properties



This icon button opens the Loop Properties Dialog Box. Identical in behavior to the D2D Loop Properties Dialog Box, except the forward and backward looping (bouncing) is not available. Refer to Figure 25 for a display of the dialog box.

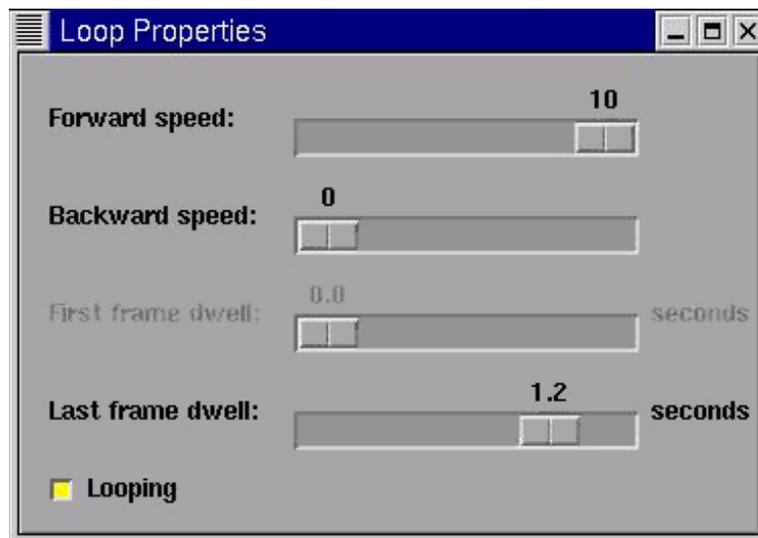


Figure 25. The Loop Properties Dialog Box.

2.1.7.7 Print



This icon button prints the contents of the Large Display Pane on a color or black and white printer. To view or edit the current print values, open the Print Dialog Box by selecting Print from the File Pull-Down Menu, found on the Menu Bar.

2.1.7.8 Viewing Modes



Pressing this icon button causes a pop-up window to appear that describes the functions of Mouse Button 1, 2, and 3, corresponding to the viewing mode that is selected. Refer to Figure 26.

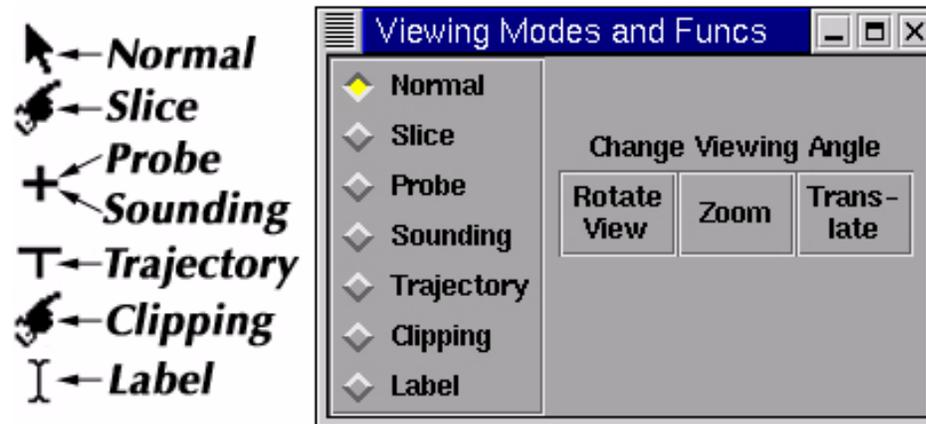


Figure 26. The Viewing Modes and corresponding Mouse Button functions with *Normal Mode* selected. Each mode is represented with a different cursor icon (shown at left).

Since there are only three Mouse Buttons available on a mouse and there are up to 10 different Mouse Button functions offered in 3D visualization, the Mouse Button functions vary depending on the Viewing Mode.

Selecting a Viewing Mode redefines how Mouse Buttons 1, 2, and 3 behave in the Large Display Pane, as well as the appearance of the Mouse Cursor. These viewing modes are mutually exclusive; only one can be selected at a time.

Figure 2, found in Subsection 2.1, summarizes the many D3D mouse button functions.

Normal

Normal Viewing Mode (the default), selected in Figure 30, is used to manipulate the viewing angle. In this Mode use Mouse Button 1, 2, and 3 to are used respectively to rotate, zoom, and pan the data in the Large Display Pane.

Rotate

By pressing Mouse Button 1 and moving the mouse while the pointer is in the Large Display Pane, the 3D image can be rotated. At any moment, using Mouse Button 1, you can control only two of the three directions of rotation. However, by releasing and re-pressing Mouse Button 1 you can change your "grip" on the box. With practice you can learn to control the box through a series of mouse moves, releasing and re-pressing Mouse Button 1 between moves. Refer to Figure 27.

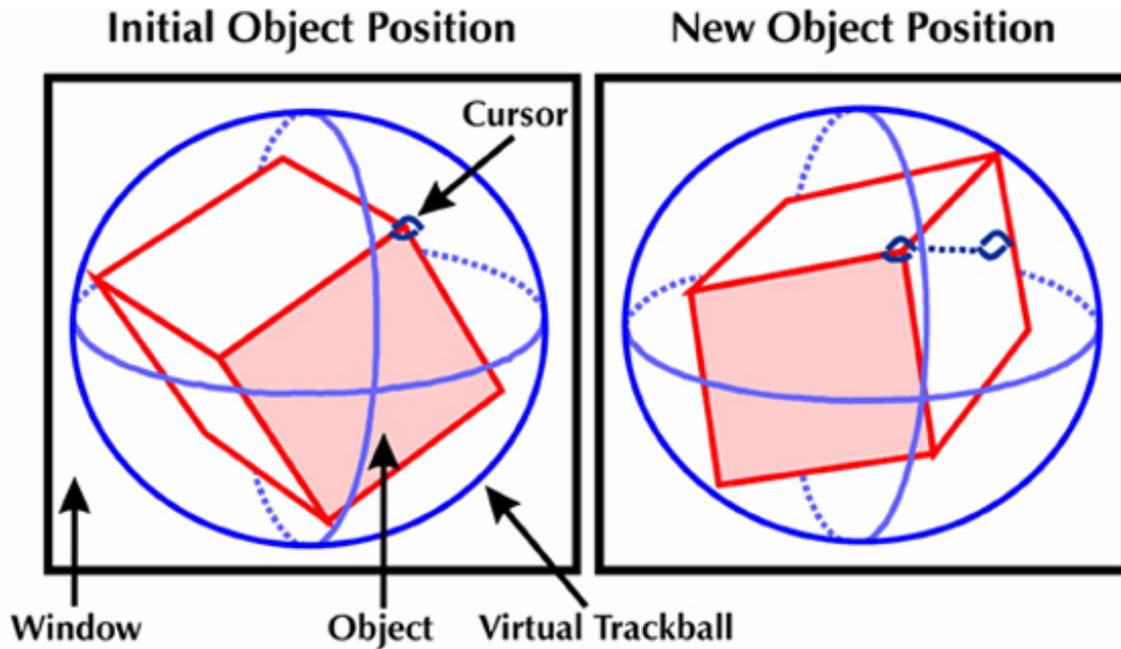


Figure 27. Rotating an Object with the Virtual Trackball.

Zoom

Pressing Mouse Button 2 and sliding the mouse upward zooms in. This makes the box appear bigger. Sliding the mouse downward zooms out. This makes the box appear smaller.

Pan

Press Mouse Button 3 and move the mouse to translate the 3D Box in the Large Display Pane. This is useful if you want to zoom in to something that is not in the center of the box. Note that the center of rotation for box rotations stays at the center of the screen rather than in the center of the box.

Slice

This mode is used to interactively reposition horizontal and vertical cross sections using Mouse Button 3 in the Large Display Pane. To move any cross section, simply point at the cross section's corner with the mouse, press Mouse Button 3 and slowly drag the cross section to a new position.

Vertical cross sections may also be moved in a perpendicular motion by "grabbing" the middle of the top or bottom edge and dragging it.

Vertical cross sections may be moved in an arbitrary motion by grabbing one top edge corner and dragging it to a new location (see Figures 42 and 48).

NOTE

A cross section may be moved while looping is on, however some jumpiness may occur because new cross sections are computed asynchronously.

Probe

This mode is used to inspect individual grid values by moving a 3D Cursor through the 3D Grid. When Probe mode is selected a 3D Cursor appears in the 3D Box which you can move around using Mouse Button 3. Use the Volume Browser Probe Pull-Down Menu to select specific fields for display in the Large Display Pane. Refer to Subsection 2.4.1.2, "Sampling Techniques - Probe."

Sounding

This mode is used to display a vertical sounding and Skew-T at the location of a moveable vertical cursor. Refer to Subsection 2.4.1.1, "Sampling Techniques - Sounding."

Trajectory

This mode is used for creating and displaying wind trajectories. Vertical displays of up to three other variables may also be added. See Subsection 2.4.2, "Trajectories."

Clipping

This mode is used to clip data out of a scene by interactively repositioning a cross section using Mouse Button 3 in the Large Display Pane. Toggle between the six directions (north, east, south, west, up and down) by clicking Mouse Button 2 in the Large Display Pane.

To move any cross section, indicated by a highlighted box, simply point at the cross section's corner with the mouse, press Mouse Button 3 and slowly drag the cross section to a new position.

Vertical cross sections may also be moved in a perpendicular motion by "grabbing" the middle of the top or bottom edge and dragging it.

Vertical cross sections may be moved in an arbitrary motion by grabbing one top edge corner and dragging it to a new location.

Label

This mode is used to create and edit text labels to annotate the image in the Large Display Pane. Typically this is used for making presentation graphics. You could add a title, your name, the date, highlight a particular feature of the data, or document the meaning of the data seen in the window.

To enter text labeling mode select the Label option from the Viewing Modes Menu. To create a text label position the pointer somewhere in the Large Display Pane and press Mouse Button 1. A vertical bar cursor appears at that location and you can now (slowly) type in the text. The <Backspace> Key can be used to correct errors. When you are finished, press <Enter>.

To move a text label to a new position, point at it with the mouse, hold down Mouse Button 2 and drag the mouse. As you move the mouse, an outline of the text is dragged with the pointer until you release the Mouse Button.

To delete a text label, point at it with the mouse and press Mouse Button 3. Be careful, you are not asked for verification before deleting a label. Once it's deleted, you can only restore it by retyping it.

Creating a bundle saves any text labels you have made. Refer to Subsection 2.1.6, "The Menu Bar," for information on bundles.

2.1.7.9 Perspective



This option toggles between perspective and orthogonal viewing projections. Perspective viewing adds depth to the 3D Display. The icon changes when the button is pressed.

2.1.7.10 Directional



These options set the Large Display Pane to a top-down view, and a north, south, west, and east directional view, respectively. Pressing Mouse Button 2 on the "T" in the Top-Down View Button resets the zoom factor and perspective values, in addition to resetting a top-down view.

2.1.7.11 Store, Recall, and Clear Views



Storing and recalling views is often used to store a single view point that took time to achieve, allowing you to toggle between it and an overhead perspective. After moving the 3D Box in the Large Display Pane to a new position, press "S" to store the view. To store additional views, continue to move the 3D Box to a new position and press "S" after each new position. Press "R" to recall and sequentially step through stored view(s). Pressing "C" clears all stored views while the Large Display Pane remains unaffected.

2.1.7.12 Frames



Use this option menu to select the number of product frames you want loaded. The default is 12 frames. There may be occurrences when you request more frames of data than are available. When this happens, the system sends a message to the Status Bar at the bottom of the Main Display. The D3D Frame behavior differs from D2D in that (1) empty frames are not filled with older data (time matching) and (2) changing frame count *after* loading a model has no effect.

2.1.7.13 Line Width



With this menu option you can enlarge or reduce the size of line width on a graphic product. As you increase the value, line width automatically increases. The purpose of this feature is to make text and symbols more visible. A performance degradation is noticed when the value of line width is greater than one.

2.2 Working with Graphic and Image Products

The application is almost completely controlled using the mouse with a graphical user interface. The best way to learn to use the system is to experiment. There is no way to harm your data from within the application. The Volume Browser is used for data and display preparation. The Large Display Pane is used to view, maneuver, and interact with the data.

2.3 The Volume Browser

The Volume Browser provides access to numerical models and other gridded data sources. Through the Browser interface, you can choose the data source(s), field(s), and rendering technique(s), which generates a customized list of model graphics or images for display.

2.3.1 The Volume Browser Dialog Box

From the Volume Pull-Down Menu on the main Menu Bar, the Volume Browser Dialog Box can be selected. The Menu Bar along the top of the Volume Browser Dialog Box has pull-down menus that contain options for controlling all the various menu choices of the Volume Browser. Figure 28 shows the Volume Browser Dialog Box when opened.

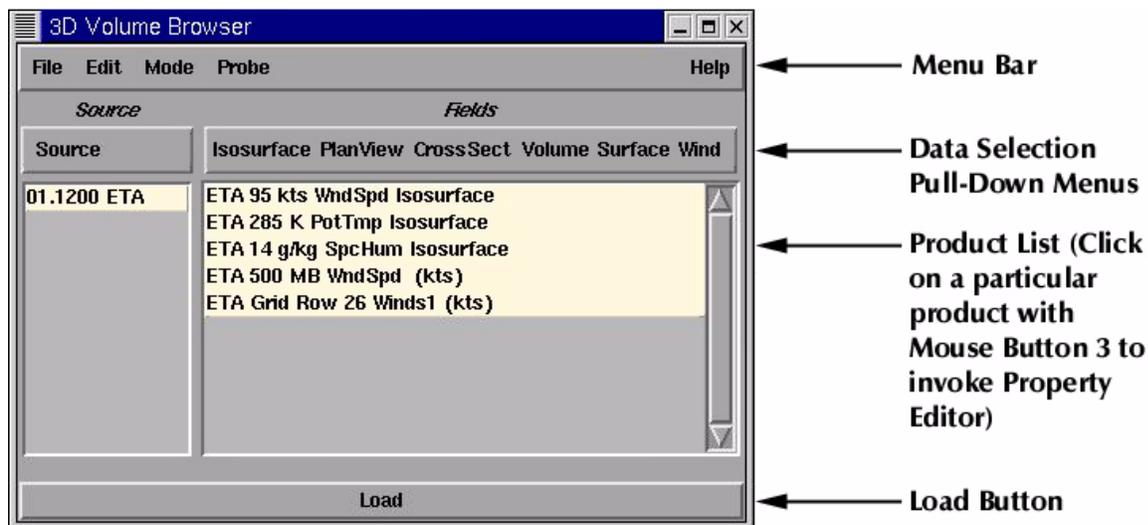


Figure 28. The Volume Browser When Initially Opened.

The Volume Browser is divided into four sections:

- the top area contains the Menu Bar; and
- the Data Selection Pull-Down Menus;
- the middle area contains the Product List and, when opened, the Property Editor (see Figure 35.); and
- the bottom area contains the Load Button.

Each of these areas are discussed in the following subsections.

2.3.1.1 The Volume Browser Menu Bar

The pull-down menus in the Volume Browser Menu Bar contain options for controlling the Volume Browser and the products chosen through the Volume Browser.

•File

There is one option under this pull-down menu. Exit closes the Volume Browser.

•Edit

There are four possible selections under this pull-down menu, as shown in Figure 29.

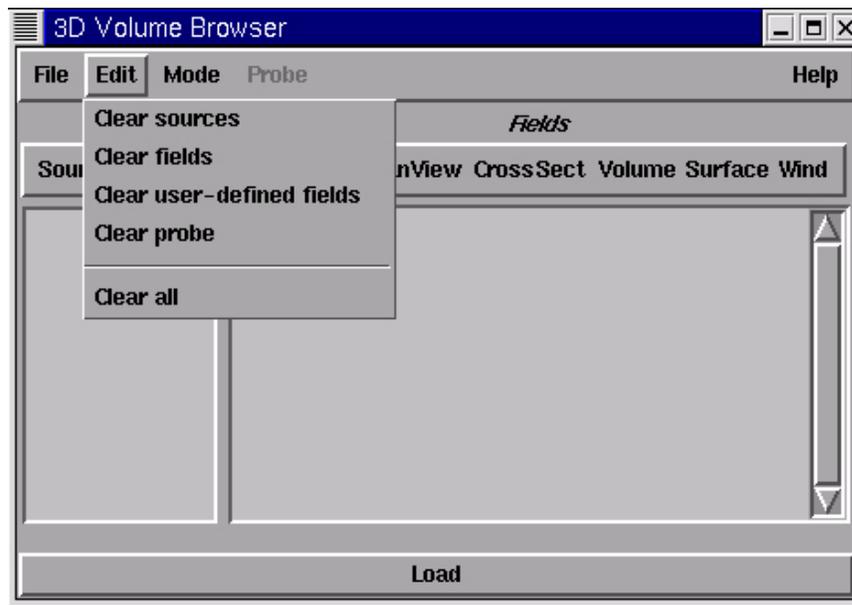


Figure 29. The Volume Browser Menu Bar - Edit Pull-Down Menu Options.

Clear sources

Clear sources, as shown in Figure 29, removes any model sources from the Sources List.

Clear fields

Clear fields, as shown in Figure 29, removes any model fields from the Fields List.

Clear user-defined fields

Clear user-defined fields, as shown in Figure 29, clears variables from all pull-down menus created by using the Variable Maker function. Refer to Subsection 5.1.

Clear probe

Clear probe list, as shown in Figure 29, removes any model products from the Probe Selection List.

Clear all

Clear all, as shown in Figure 29, removes any model sources and fields from the Sources, Fields, and Probe Selection Lists.

•Mode

There are seven possible selections under this pull-down menu, as shown in Figure 30.

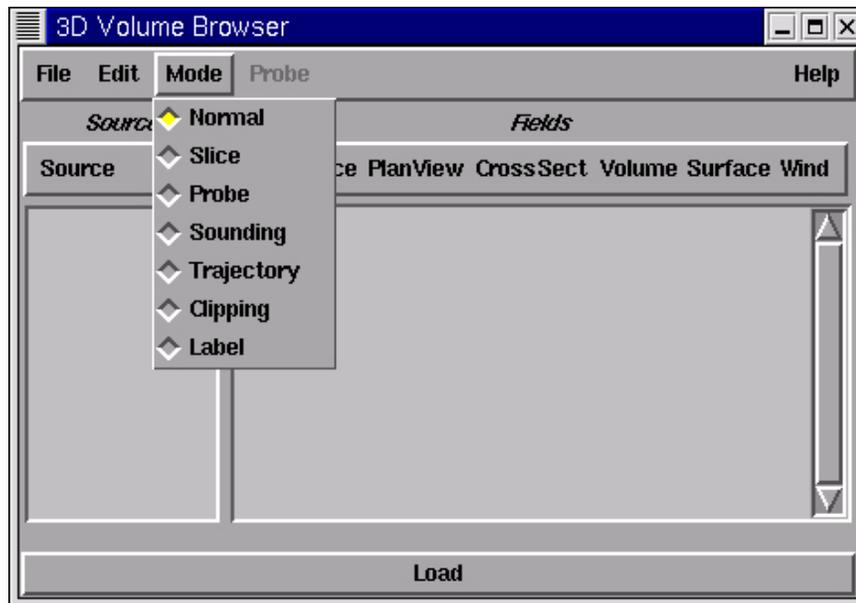


Figure 30. The Volume Browser Menu Bar - Mode Pull-Down Menu Options.

For additional information, refer to Subsection 2.1.7.8, "Viewing Modes."

•Probe

This pull-down menu, shown in Figure 31, provides a user-selectable list of fields to probe in the Large Display Pane. The Probe Pull-Down Menu is disabled unless the Viewing Mode is set to Probe.

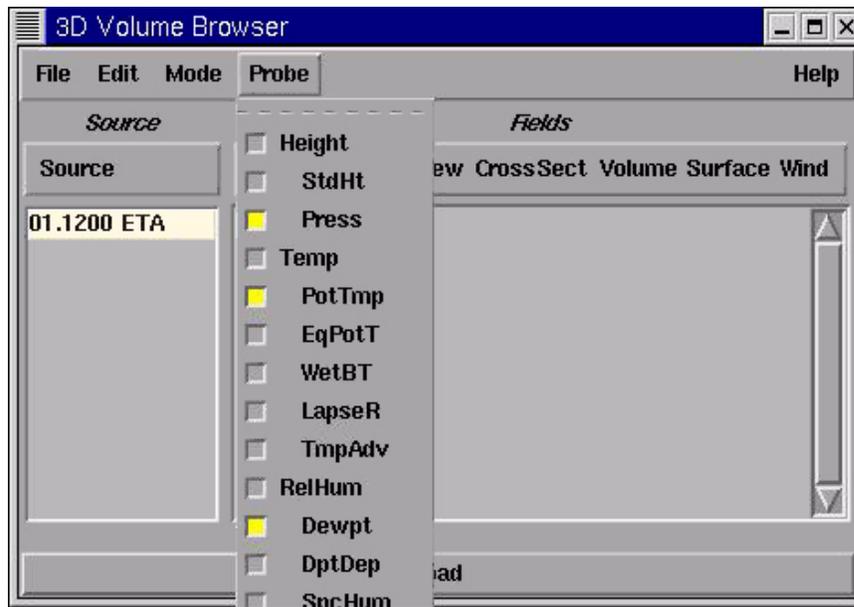


Figure 31. The Volume Browser Menu Bar - Probe Pull-Down Menu Options.

It is sometimes useful to be able to inspect individual data values at various locations in the 3D volume. When Probe mode is selected, a 3D Cursor appears in the 3D Box which you can move around using Mouse Button 3. The selected field's value, for the current time step, is printed along the left edge of the Large Display Pane.

•Help

This pull-down menu, shown in Figure 32, provides on-line assistance and information about the Volume Browser.

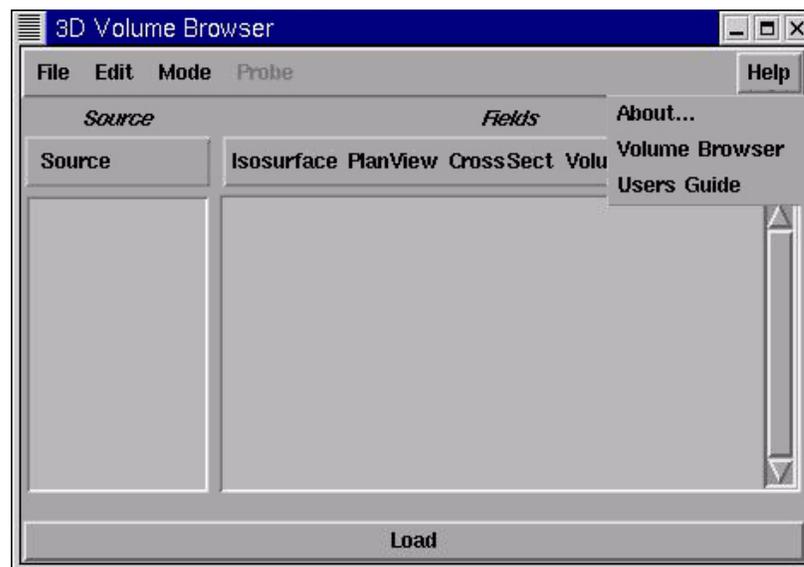


Figure 32. The Volume Browser Menu Bar - Help Pull-Down Menu Options.

About

Provides the date of the Volume Browser software.

Volume Browser

Clicking on Volume Browser connects you, via Netscape, to the “Volume Browser” subsection of the *D3D On-Line User’s Guide*.

Users Guide

Contents connects you, via Netscape, to the Table of Contents of the *D3D On-Line User’s Guide*.

2.3.1.2 Data Selection Pull-Down Menus

All the data available through the Volume Browser are stored in gridded format and generated as graphic or image products. For each product you display, sources, rendering techniques, and fields are chosen from the menus located in the top third of the Volume Browser.

The many choices of rendering techniques available in D3D sets the D3D Volume Browser apart from the D2D Volume Browser. The rendering techniques available include: isosurfaces; vertical and horizontal cross section contours and images; surface contours and images; and volume visualization (Subsection 2.3.2, “Volume Browser - Rendering Techniques”).

The techniques available to sample the gridded data in D3D are a vertical sounding/variable plot and a virtual data probe (Subsection 2.4.1, “Sampling Techniques”). An additional visualization technique displays trajectories (Subsection 2.4.2, “Trajectories”).

•Sources

The Sources Menu, shown in Figure 33, contains numeric models and other gridded data, currently limited to volume radar. This menu is scale-dependent, which means its contents change depending on what scale you choose.

NOTE

Currently, D3D only allows you to display products from one source at a time.

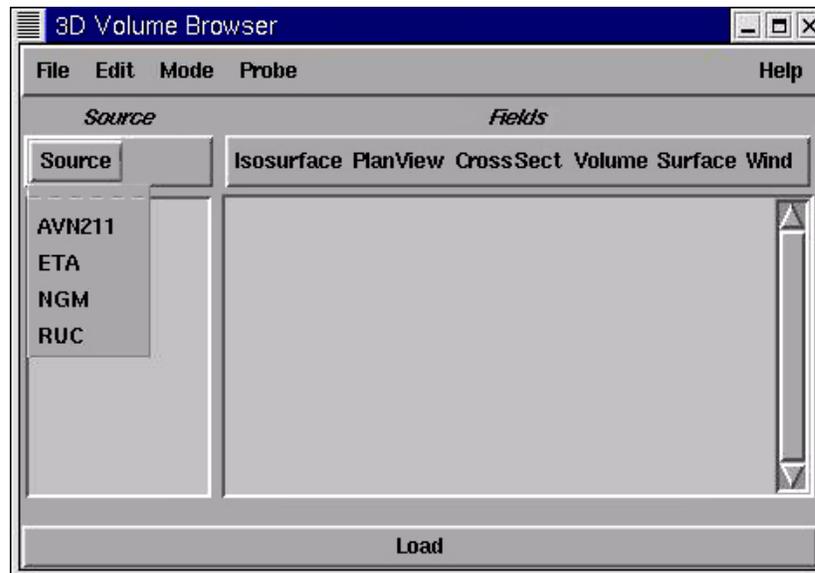


Figure 33. The Volume Browser - Source Pull-Down Menu. Note - Rendering Techniques Pull-Down Menus are disabled until a source is selected.

The sequence of selecting items from pull-down menus is order specific, proceeding from left to right. To reinforce this selection order, the Rendering Techniques Menus are disabled until a source is selected.

•Fields

Once a source is selected, the available data fields are listed in the Rendering Techniques Pull-Down Menus, see Figure 34. Related data fields are grouped together in these menus.

NOTE

Available menu items appear in black, unavailable menu items appear in gray.

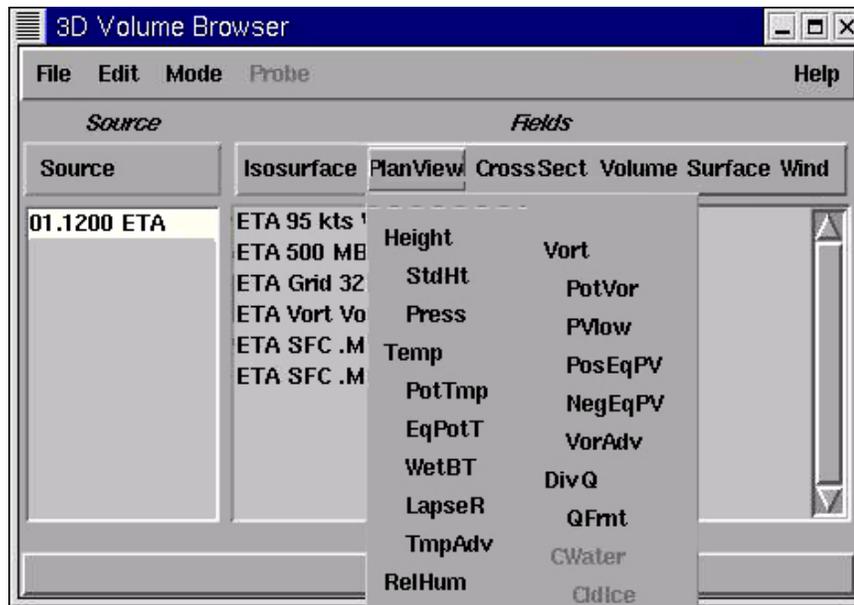


Figure 34. The Volume Browser - Plan-View Pull-Down Menu Showing Choice of Fields to Display.

A key interface design for the D3D Volume Browser was to pair field selection with rendering technique selection to create the customized list of products to display, namely the Product List. This eliminates the implicit redundancy in the Product List found, by design, in D2D.

With the amount of information present in 3D visualization, it is important to avoid automatically adding products not explicitly requested. Combining rendering technique and field selection explains why the complete list of available fields is found under each rendering technique pull-down menu.

•Selecting a Field

To display a field as a product, (1) decide on a rendering technique, (2) select that rendering technique pull-down menu, and (3) click on the desired field from the pull-down menu using Mouse Button 1. A product name appears in the Product List. See Figure 34.

2.3.1.3 Using the Product List

Once a field is selected, its product name (composed of a model name, a value, a field name, and the rendering technique) appears in the Product List. By design, products in the Product List are highlighted and ready to load. You can select or deselect the products you want to load pressing Mouse Button 1 over a product name.

Pressing **Load** generates all highlighted (selected) products for all time steps. The pointer changes to a watch while the system is loading products.

Toggling Looping on allows you to see the time dynamics.

NOTE

The products are generated asynchronously with the looping, so you may not see new products for all the time steps as the clock hand makes its first revolution. These products appear on successive clock revolutions.

2.3.1.4 The Property Editor

The ability to adjust the properties of a product in the Product List (from their default values) is available through the product’s Property Editor.

Pressing Mouse Button 3 over a product name in the Product List causes a popup menu (with value, color, and other widgets) to appear at the bottom of the Volume Browser, as illustrated in Figure 35. The product name is also modified to say (***) Edit mode (***) indicating that, currently, this product is being edited.

NOTE

Only one product at a time can be edited.

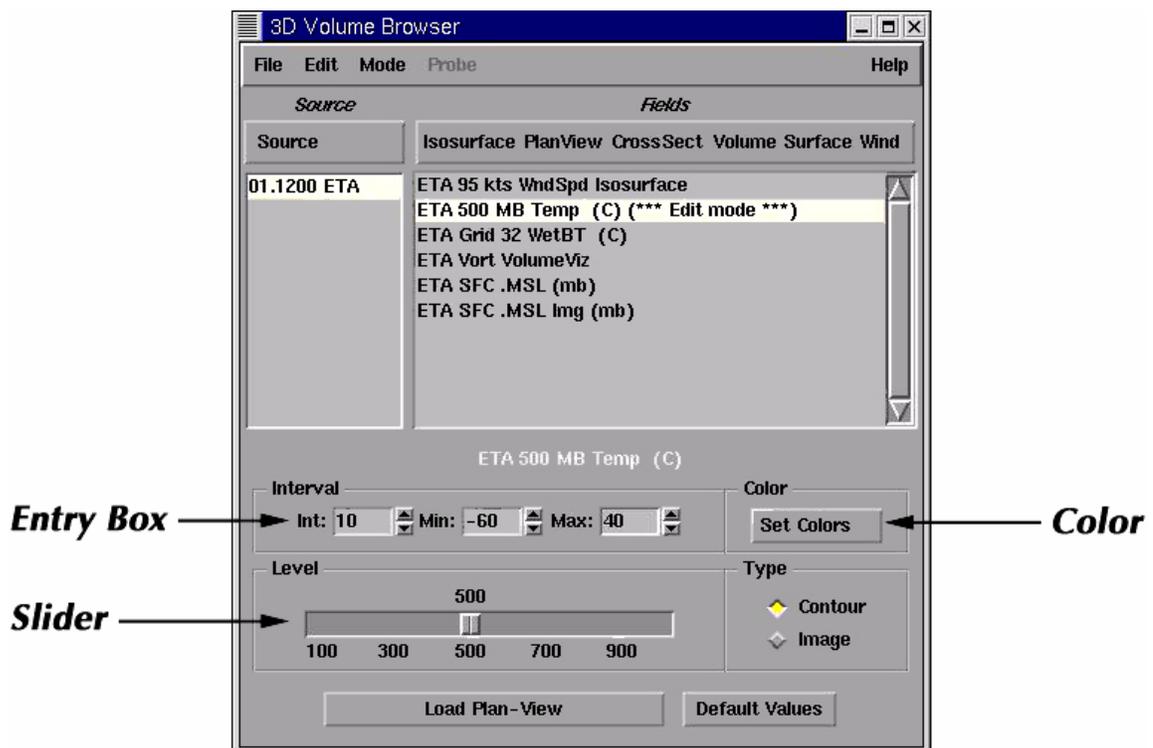


Figure 35. The Volume Browser - Plan-View Property Editor Opened.

To close the Property Editor again click on the product name in the Product List with Mouse Button 3. To edit properties on another product from the Product List, you can click on that product name with Mouse Button 3

without having to first close the current Property Editor. A list of property editors widgets are described as follows.

•Entry Box

To change entry box values either use the small arrow buttons to increase/decrease the value or type in a value, then press Return using your keyboard when the focus is on the entry box (indicated by a highlighted black box).

•Slider

To change the slider value, press and drag the slider to a new value with either Mouse Button 1 or 2. You can also click to a new value with Mouse Button 2. To change the slider amount by a unit of one, click Mouse Button 1 on either side of the slider indicator.

•Color

To change the color of a product, press the Set Colors Popup Menu and choose one of the nine colors from the popup menu. If you want more color selection, choose Edit Colors from the Set Colors Popup Menu. A Colors Editor Dialog Box appears with three sliders labeled Red, Green, Blue, and for some products a fourth slider labeled Opacity, and a Color Wheel, see Figure 36.

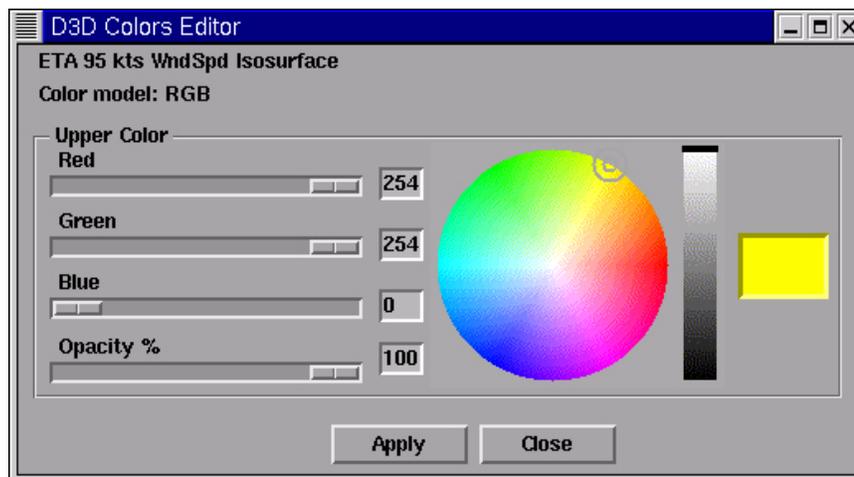


Figure 36. Colors Editor.

To change the product color, just move the red, green, and blue sliders or move the Color Wheel Centroid (a circle with a dot in the middle) around in the Color Wheel. To change the opacity, just move the opacity slider to the desired value. Select Apply to color the product, or Close to cancel. To change the colors of a product colored by a range of color values, choose Edit Colors. You can use this to modify existing color tables, or create new ones and save them for future use.

Figure 37 shows the Image Colors Editor.

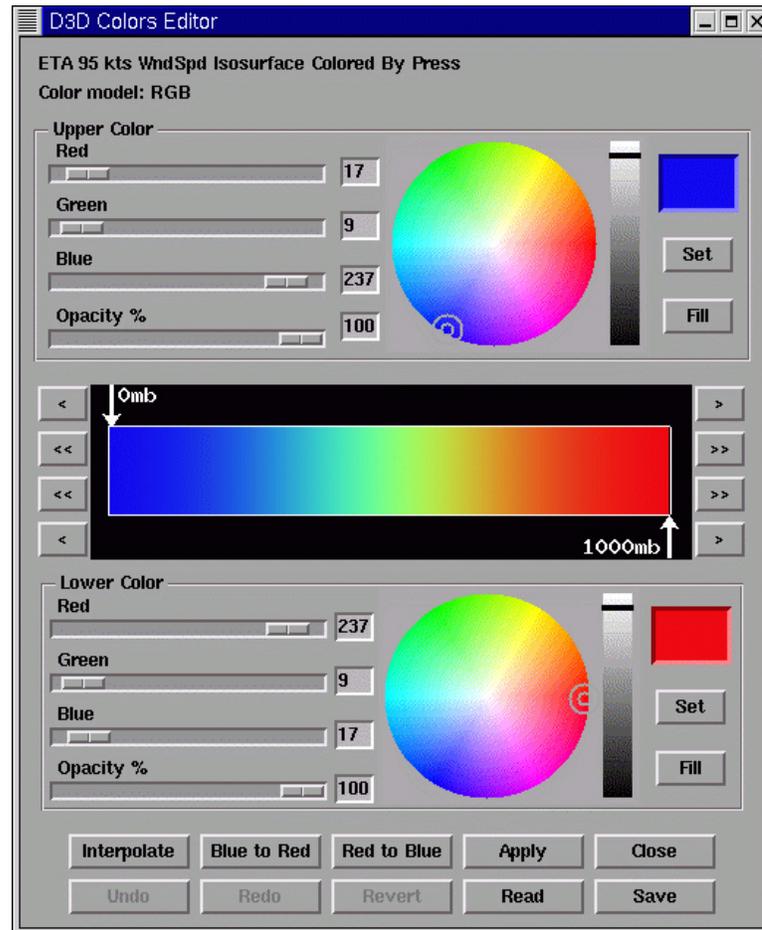


Figure 37. Image Colors Editor.

The Colors Editor Dialog Box

This section describes the features of the Colors Editor. Note that the controls in the upper color portion of the dialog box are mirrored in the lower color portion. The controls in both portions behave the same way.

Color Model

RGB (Red, Green, Blue) Color Model interpolates in a straight line across the Color Wheel from the color in the upper Color Swatch to the color in the lower Color Swatch. The intermediate colors are not included.

RGB Slider Bars

These slider bars allow you to make incremental changes in the hue, saturation, or brightness, or in the amount of red, green, or blue that is present in the color displayed in the Color Swatch. These values can

be set using the slider bar or by typing in a value in the entry box to the right of the slider.

Red, Green, Blue

Red, green, and blue values all range from 0 - 255 and reflect the amount, or intensity, of each color present in the displayed color. Changing these values moves the Color Wheel Centroid across the Color Wheel, but not necessarily along a radial.

Opacity

Opacity ranges from 0 to 100 percentage. The higher the value, the more opaque the product appears. The lower the value, the more transparent the product appears.

Color Wheel

The box on the right side of the dialog box contains the Color Wheel. The Color Wheel Centroid (a circle with a dot in the middle) can be dragged anywhere within the circle to change the color displayed in the Color Swatch (more on this later in this subsection). Moving the Centroid around the circle also changes the RGB values.

Brightness

Brightness values are given in percent and determine the amount of black present in the color. Brightness can also be thought of as the intensity of the color.

Color Swatch

To the far right of the Color Wheel is the Color Swatch. Moving the Color Wheel Centroid changes the color in the swatch.

Set

These buttons, located in both the upper and lower portions of the Colors Editor, insert a narrow line of color into the current Color Bar at the location of the Color Pointer. The color inserted is the one displayed in the corresponding (i.e. upper or lower) Color Swatch.

Fill

These buttons replace the colors contained within the range specified by the Color Pointers in the Color Bar with the colors in the upper or lower Color Swatch.

Color Bar

The Color Bar contains the color table of the current image and is located in the middle of the dialog box.

The arrowhead Color Pointers along the top and bottom halves of the Color Bar can be dragged to delineate a range of the color table; that is, the portion of the Color Bar contained between the top and bottom arrows. The Color Pointers move independently of one another, but they cannot move past each other. When aligned, they move in unison and delineate a single point along the Color Bar.

As the Color Pointers are dragged along the Color Bar, they display the image values corresponding to the color pointed to. Thus, for example, if a temperature cross section is displayed, moving the Color Pointer shows the temperature values corresponding to the colors in the Color Bar.

At each end of the Color Bar are left- and right-pointing arrows. These are used to move the Color Pointers along the Color Bar an increment at a time. The > and < Buttons move the Color Pointers in smaller increments than the >> and << Buttons.

Edit Controls

At the bottom of the dialog box are the Edit Controls.

Interpolate

This button fills the specified range with a linear (RGB) interpolation between the colors in the upper and lower Color Swatches. A linear interpolation is equivalent to moving in a straight line across the Color Wheel.

Blue to Red

This button fills the specified range of the Color Bar with the color spectrum, blue through red inclusive.

Red to Blue

This button fills the specified range of the Color Bar with the color spectrum, red through blue inclusive.

Apply

This button applies the Color Bar changes to the displayed product.

Close

You close the Editor with this button.

Undo

This button allows you to successively undo changes made to the color table.

Redo

This button successively re-does what was last undone.

Revert

This button returns the Color Bar to its original state.

Read...

This button reads a color table from a file completely filling the Color Bar from its minimum value to its maximum value.

Save...

Use this button if you want to save a color table. A dialog box asks you to enter a name for your color table and then lets you save it or cancel the command.

•Load “Technique”

Press the **Load “Technique”** Button to generate a product for all time steps after changes have been made.

•Default Values

Default Values resets the properties of all the current **Property Editor** widgets to their original values.

2.3.2 The Volume Browser - Rendering Techniques

2.3.2.1 Isosurface

•Description

An isosurface is a 3D contour surface of a field at a particular value. It depicts a volume bounded by the value allowing you to visibly see the 3D structure of the field.

For isosurfaces with a positive (negative) value, the volume inside the isosurface contains values greater (less) than the isosurface value. Likewise, the volume outside contains values less (greater) than the isosurface value.

Refer to Figure 38 for an example.

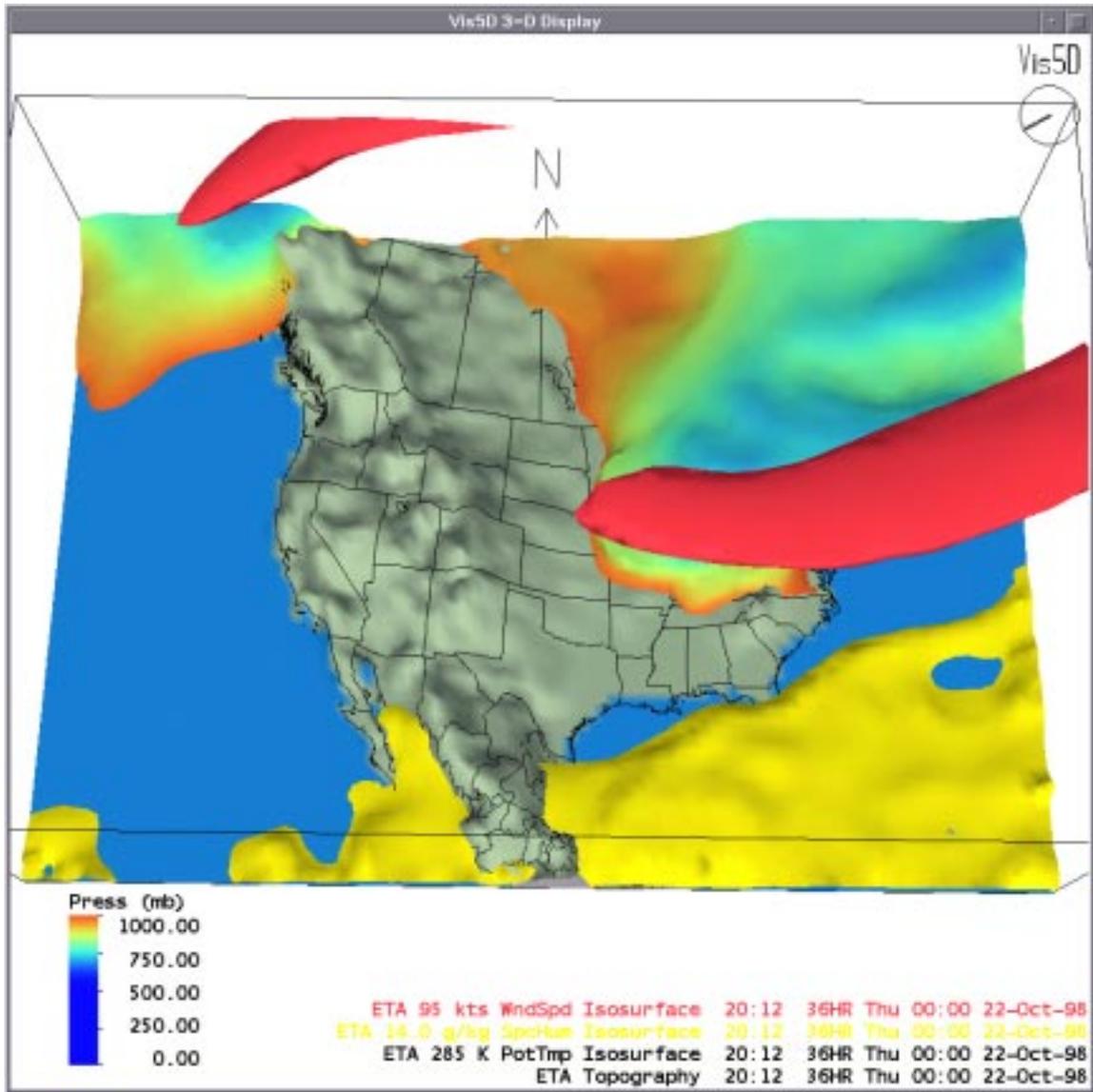


Figure 38. ETA 95 kts Wind Speed Isosurface; ETA 14.0 g/kg Specific Humidity Isosurface; ETA 285 K Potential Temperature Isosurface Colored by Pressure.

•Property Editor

The Isosurface Property Editor, as shown in Figure 39, has several options.

Figure 39. The Volume Browser - Isosurface Property Editor.

Value

To change the isosurface value, move the **slider**. Changing **Min** or **Max** values causes the extents of the **slider** (and the color table which maps data values to colors) to reset to these values.

Immediate mode

Select **Immediate mode** to *automatically* have changes to any isosurface widget generate a new isosurface for all time steps. Otherwise, press the **Load Isosurface** Button to generate an isosurface for all time steps after changes have been made.

Color

Set Colors/Edit Colors

To change the color of the solid colored isosurface, press Set Colors Popup Menu and choose one of the nine colors from the popup menu. To invoke the Colors Editor, select Edit Colors.

Solid

An isosurface may be either a solid color or colored according to the values of another field. By selecting Solid (default) on the Property Editor's Color section you tell D3D to color the field a solid color and by selecting a name other than Solid, you tell D3D to color the isosurface by another field.

To change the colors of this second field, press Edit Colors. An editable color table appears, see Figure 37. You can modify the color table, which maps data values to colors, by using the Colors Editor widgets.

To illustrate coloring one field by the values of another field, load a model of, say, LAPS. Make an isosurface of cloud water at 1.0 g/m^3 . Initially, the isosurface would be a solid color. Open the Properties Editor then change Solid to Height. Press Load. The cloud water isosurface is now sampling the height field.

Using the color legend as a reference you can more easily determine the height of the clouds. By pressing Edit Colors from Property Editor the Colors Editor appears allowing you to modify the mapping of height values to colors.

For more information, refer to the Color Subsection, described under Property Editor in Subsection 2.3.1.4, "The Property Editor."

Overlays

Isosurfaces that are relatively smooth and have only one value for each horizontal location (typically those of pressure, height, temperature, etc.) can be overlaid with graphic products: wind barbs, streamlines and contour lines. Isosurfaces that meet this criteria are sometimes referred to as a "well behaved" isosurface.

Isosurfaces that are inconsistent throughout a 3D grid and are not smooth nor, often, large enough to generate meaningful or intelligible graphic products on their surface such as relative humidity values or divergence, for example, and cannot be overlaid with graphics products.

To overlay a graphic product, select an item from the Overlay pull-down list. The item is immediately entered into the Volume Browser customized list of products to display. The overlay product is labeled to reflect the

connection to the isosurface associated with the product. The overlay product's Property Editor is restricted, yet still allows you to set contour interval, minimum, maximum, colors, etc. You may load multiple overlays to an isosurface. To break the connection, select None, or better yet, select Clear from the Toolbar.

2.3.2.2 Plan View

•Description

Plan-View allows you to look at a horizontal cross section of data. The cross section can be depicted as contour lines or a colored image (or both), as in Figure 40).

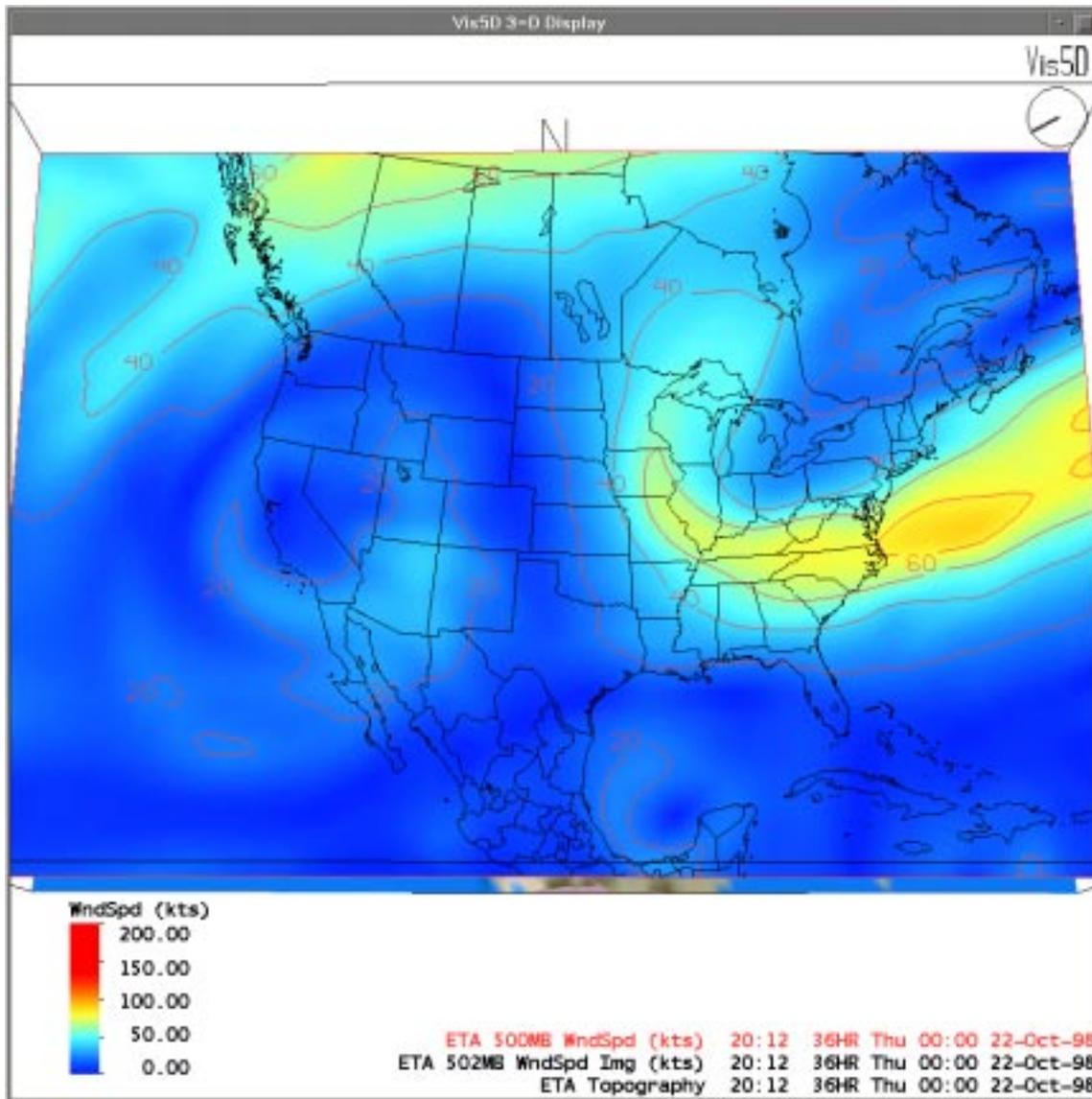


Figure 40. ETA 500MB Wind Speed (kts) Plan-View Displayed as an Image with Contours.

•Property Editor

The Plan-View Property Editor, as shown in Figure 41, has several options.

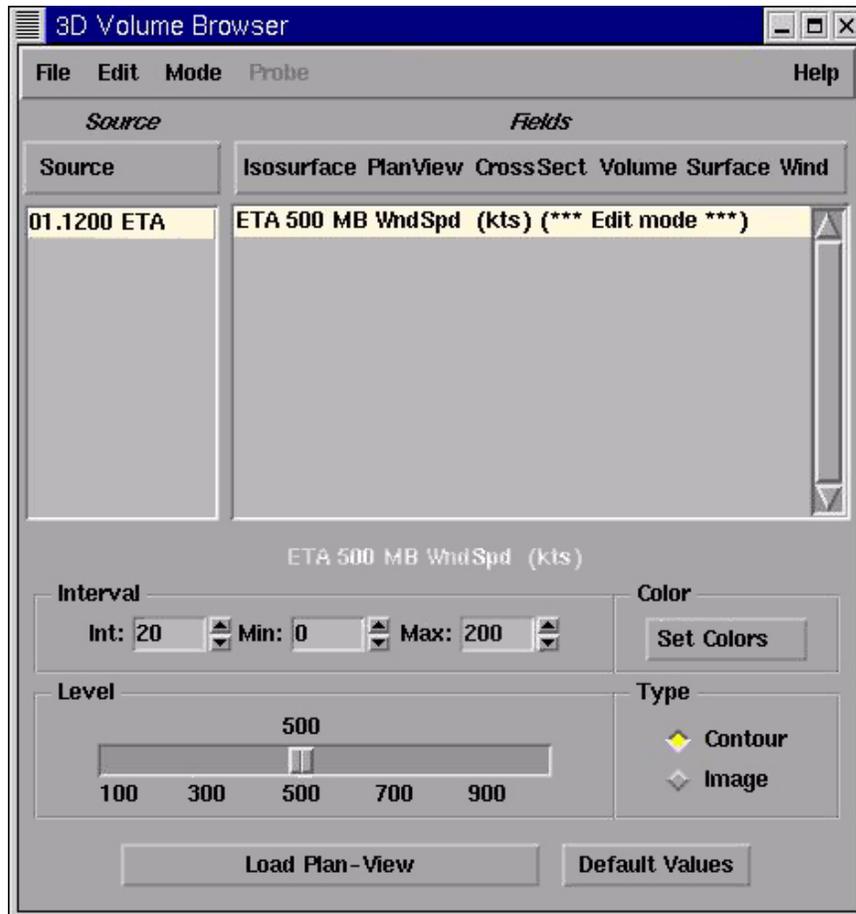


Figure 41. The Volume Browser - Plan-View Property Editor.

Interval

You can enter an interval to use between contour lines, decreasing the interval causes denser contour lines to be generated, increasing the interval results in sparser lines.

You can specify a range of values (min, max) which causes only contour values between min and max to be drawn.

Level

The initial position for the cross section is the middle of the box that surrounds the data set. The exact cross section location in terms of pressure level is given by a small numeric label near one corner of the cross section (see Figure 48).

To change the plan-view level move the slider. Changes to **Level** *automatically* generates a new plan-view for all time steps.

The position of the cross section can also be changed interactively in the Large Display Pane using the mouse. To do so, you must first be in *Slice* mode. You do this by selecting the *Slice* from the **Mode** Pull-Down Menu.

To move the cross section, simply move the pointer to the cross section's corner, press Mouse Button 3 and slowly drag it to a new position (see Figure 48).

NOTE

A cross section may be moved while looping is on, however, some jumpiness may occur because new cross sections are computed asynchronously.

Type

The plan-view can be depicted as contour lines (by default) or as a colored image by selecting contour or image, respectively.

Color

To change the color of the contours, press the **Set Colors** Popup Menu and choose one of the nine colors from the popup menu.

For further information including coloring an image, refer to the Color Subsection, described under Property Editor in Subsection 2.3.1.4, “The Property Editor.”

Load Plan-View

Press **Load Plan-View** to generate a plan-view for all time steps after changes have been made. Again, changes to **Level** automatically generates a new plan-view for all time steps.

2.3.2.3 Slice

•Description

Slice allows you to view a vertical cross section of data. The cross section can be depicted as contour lines or a colored image, or both. Refer to Figure 42 for an example.

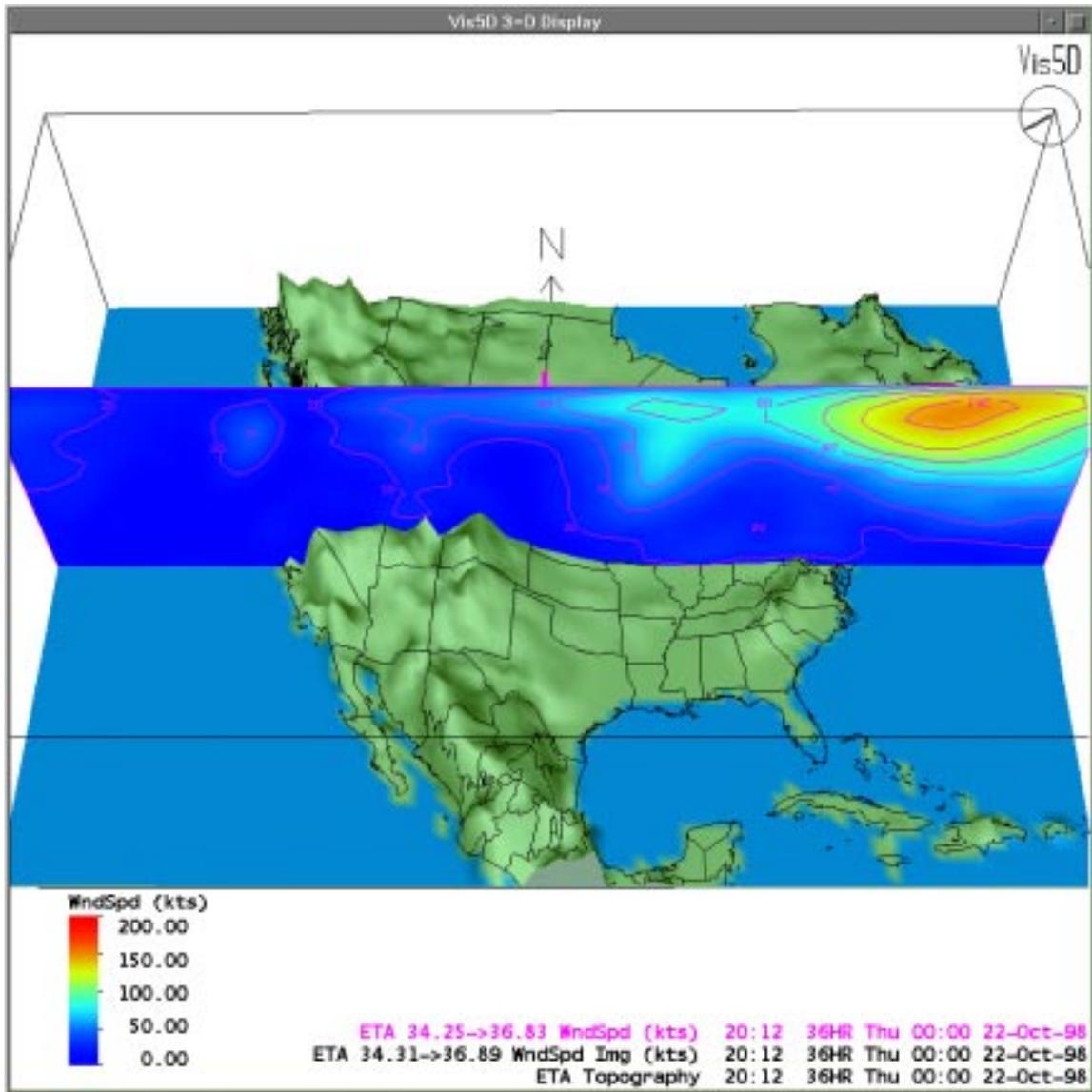


Figure 42. ETA Grid 32 Wind Speed (kts) Slice Displayed as an Image with Contours.

•Property Editor

The Slice Property Editor, as shown in Figure 43, has several options.

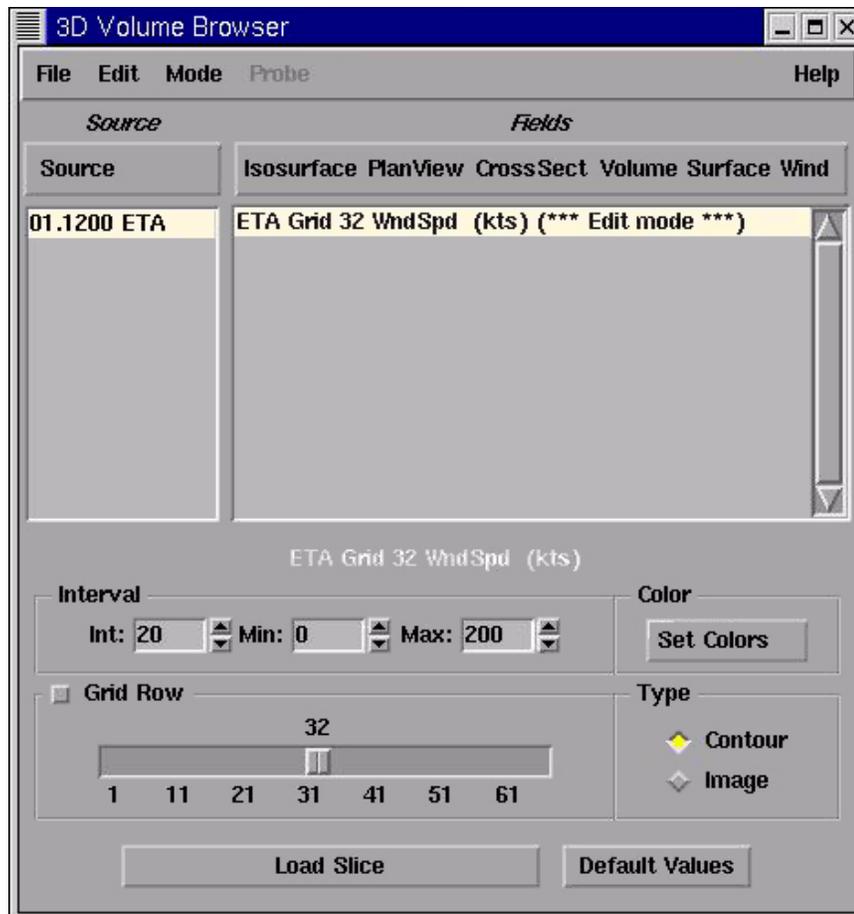


Figure 43. The Volume Browser - Slice Property Editor.

Interval

You can enter an interval to use between contour lines. Decreasing the interval causes denser contour lines to be generated. Increasing the interval results in sparser lines.

You can specify a range of values (min, max) which causes only contour values between min and max to be drawn.

Grid Row/Column

The initial position for the cross section is the middle of the box that surrounds the data set. The exact cross section location in terms of latitude and longitude is given by small numeric labels near one corner of the cross section (see Figure 48).

To change between grid rows and grid columns, select the button next to the word **Grid**. To change the grid row/column, move the slider.

Changes to row/column *automatically* generates a new slice for all time steps.

The position of the cross section can be changed interactively in the Large Display Pane using the mouse. To do so you must first be in *Slice* mode by selecting the *Slice* from the **Mode** Pull-Down Menu.

This method allows you to position a vertical cross section diagonally if desired (see Figure 48).

Type

The slice can be depicted as contour lines (by default) or as a colored image by selecting contour.

Color

To change the color of the contours, press the **Set Colors** Popup Menu and choose one of the nine colors from the popup menu.

For further information including coloring an image, refer to the Color Subsection, described under Property Editor in Subsection 2.3.1.4, “The Property Editor.”

Load Slice

Press **Load Slice** to generate a slice for all time steps after changes have been made. Changes to **Grid Row/Column** slider value automatically generates a new slice for all time steps.

2.3.2.4 Volume

•Description

Volume rendering is a technique for displaying a 3D field as semi-transparent colored fog. Though volume renderings of some fields don't look particularly informative, others can be displayed effectively with the right color mapping. Only one volume may be displayed at a time (unlike isosurfaces).

The volume rendering feature in D3D renders volumes very slowly in software mode. Refer to Figure 44 for an example of volume rendering of wind speed.

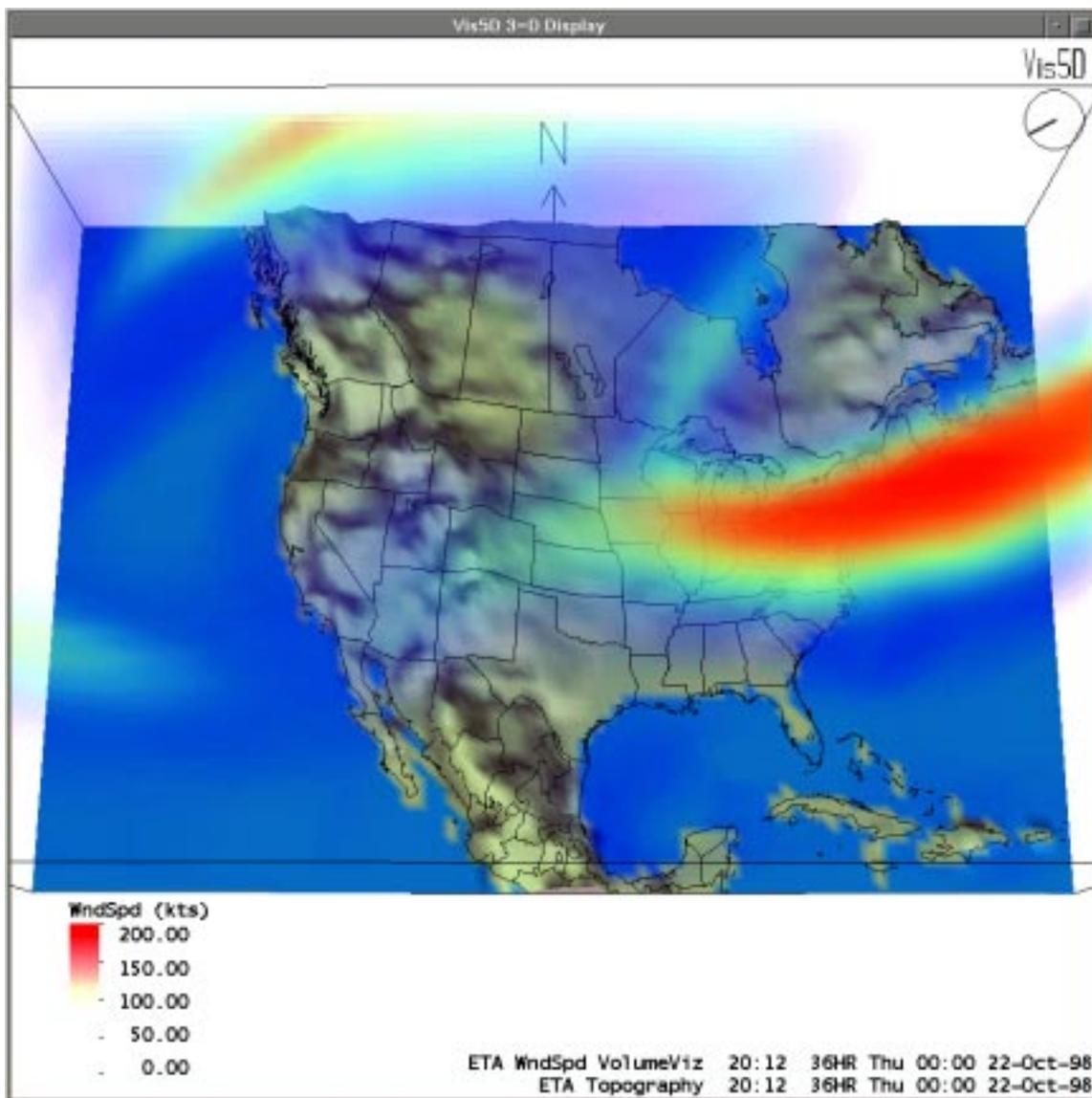


Figure 44. ETA Wind Speed Volume Visualization.

•Property Editor

The Volume Property Editor, as shown in Figure 45, has one principle option.

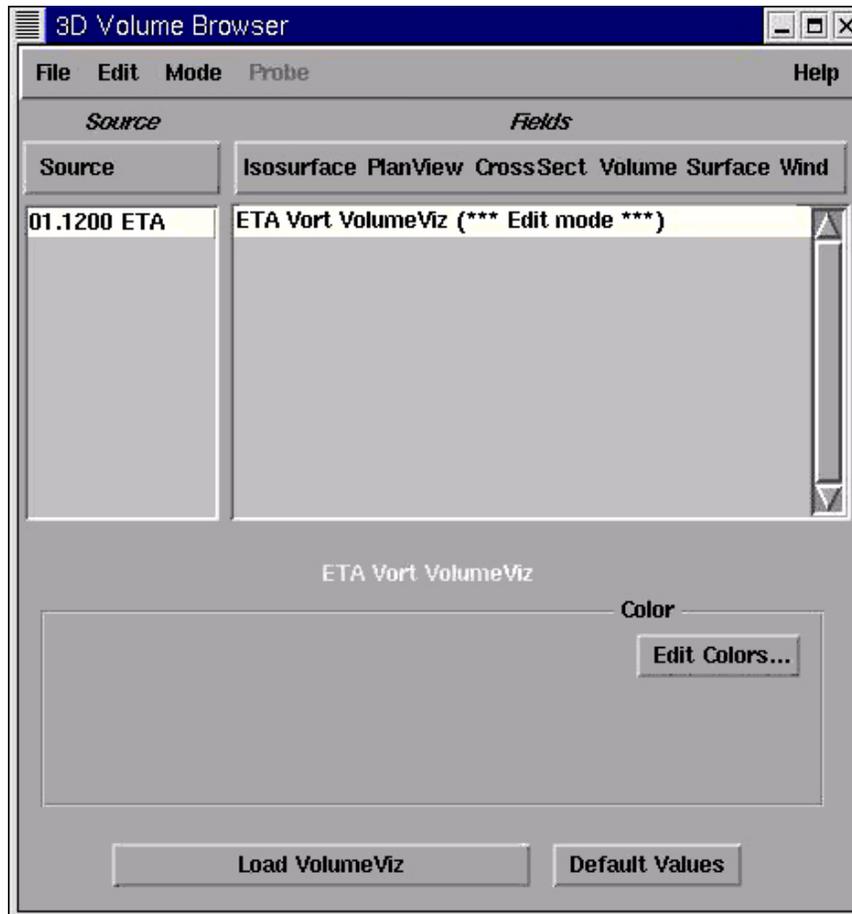


Figure 45. The Volume Browser - Volume Property Editor.

Color

Editing the color table is done exactly the same way as it is for images described in the Color Subsection, under Property Editor in Subsection 2.3.1.4, “The Property Editor.”

That is, using the pointer or the keyboard arrow keys, you can change the function which maps data values to color and transparency.

Again, the transparency can be changed while holding down the SHIFT Key and drawing a curve with the pointer or pressing the Up/Down Arrow Keys.

Load Volume

Press **Load Volume** to generate a volume for all time steps only if the field has changed. Changes to the color table take effect immediately.

Default Values

Default Values do not apply here.

For those who are curious about the implementation of this feature, the volume rendering is made as follows:

1. Examine the current viewing transformation to determine which axis of the 3D Box is most nearly parallel to the view direction.
2. Create a number of colored slices perpendicular to that axis which map data values to colors and opacity.
3. Render the colored slices in back to front order.

The alpha values at vertices are interpolated and blended to make smooth transitions between and within slices.

Despite the simplicity of the algorithm, most fields are rendered acceptably. Those that aren't might be improved by adjusting the color and opacity mappings.

While more attractive volume rendering techniques are known, this technique can be implemented quickly on many systems.

2.3.2.5 Surface

•Description

Surface allows you to look at data on the 3D topography surface. The surface data can be depicted as both contour lines and a colored image.

To display a field on the topography surface, you first select Surface's Pull-Down Menu, second choose either the *Contour* or *Image* Menu, then click on the desired field. Refer to Figure 46 for an example of an image display with contours.

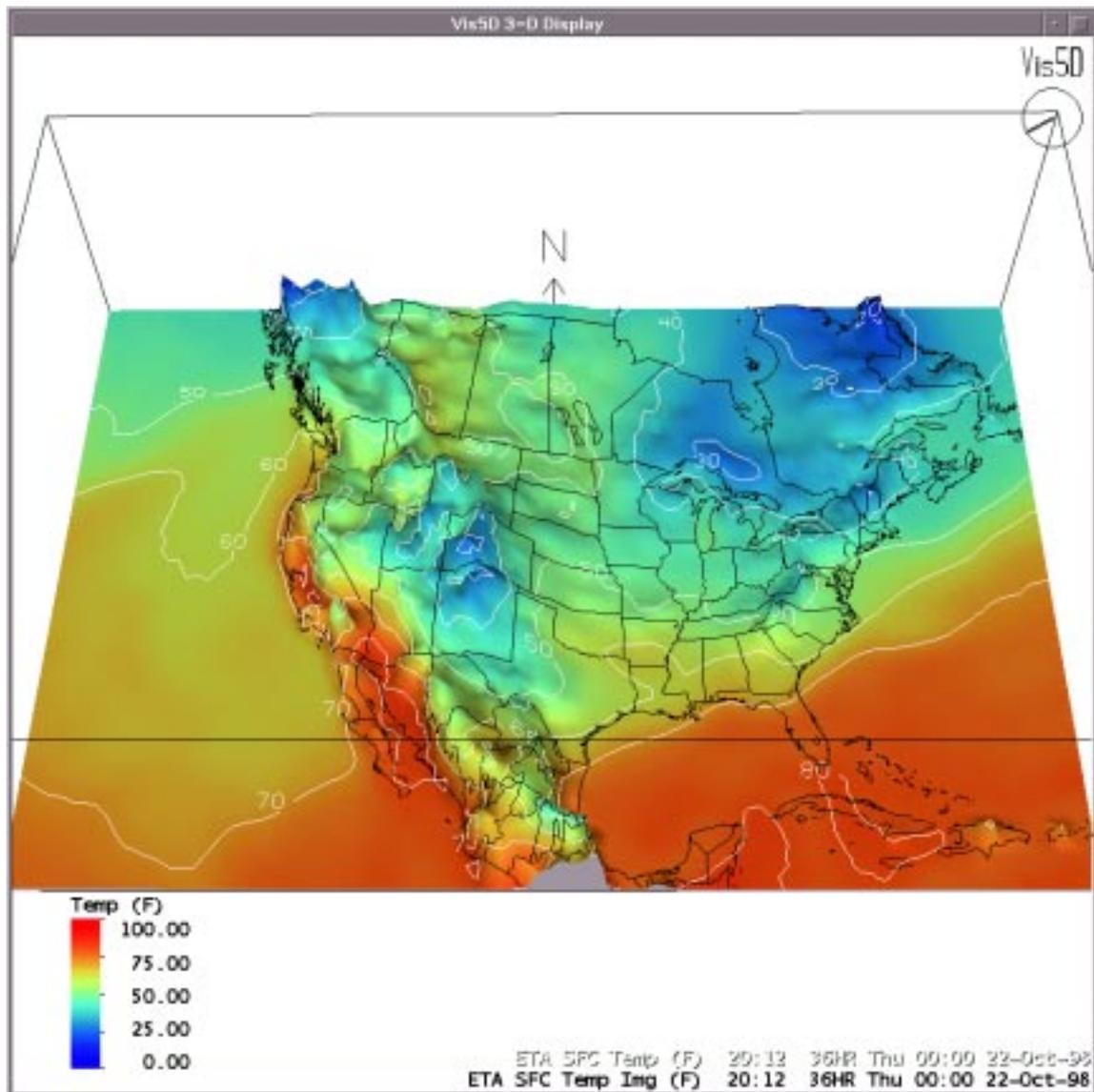


Figure 46. ETA Surface Temperature (F) Displayed as an Image with Contours.

•Property Editor

The Surface Property Editor, as shown in Figure 47, has several options.

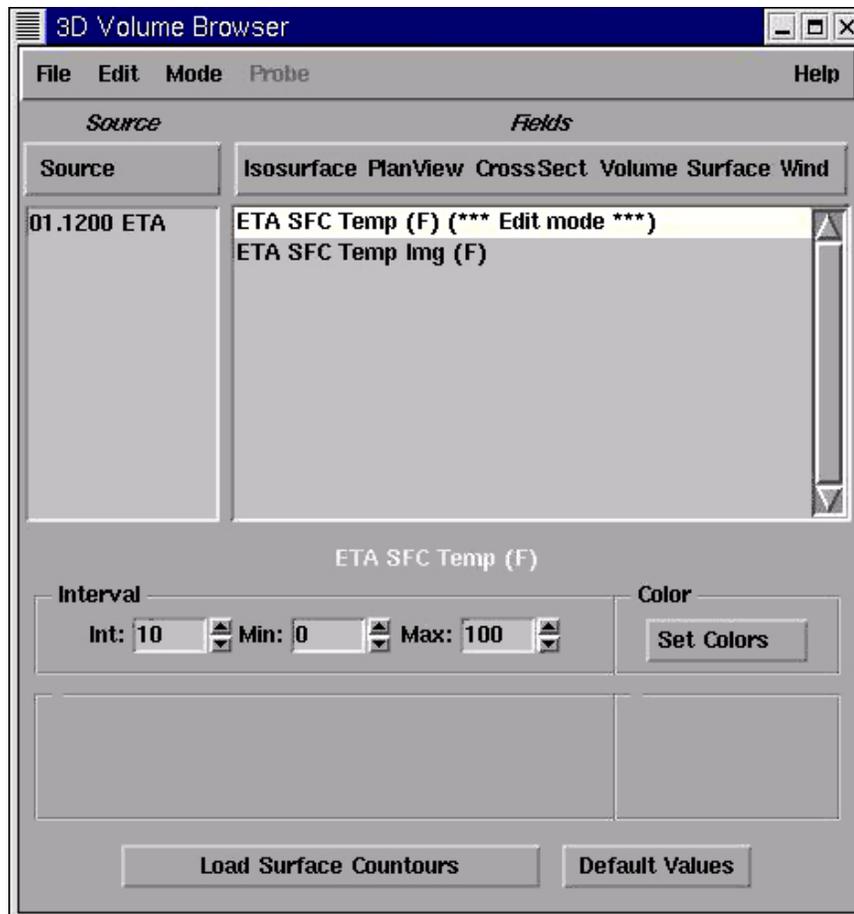


Figure 47. The Volume Browser - Surface Property Editor.

Interval

You can enter an interval to use between contour lines. Decreasing the interval causes denser lines to be generated. Increasing the interval results in sparser lines. You can specify a range of values (min, max) which causes only contour values between min and max to be drawn.

Color

To change the color of the contours, press the **Set Colors** Popup Menu and choose one of the nine colors. For further information including coloring an image, refer to the Color Subsection, described under Property Editor in Subsection 2.3.1.4, “The Property Editor.”

Load Surface

Press **Load Surface** to generate a surface for all time steps after changes.

2.3.2.6 Winds

•Description

Winds allows you to look at horizontal plan views and vertical cross sections of wind data in the 3D volume and at the surface. Wind data can be depicted as wind glyphs (barbs/arrows) and as streamlines labeled Wind and Streamlines, respectively. Wind streamlines show wind airflow as connected line segments. To plot winds at the surface choose the Volume Browser's surface rendering technique. Refer to Figure 48 for a display.

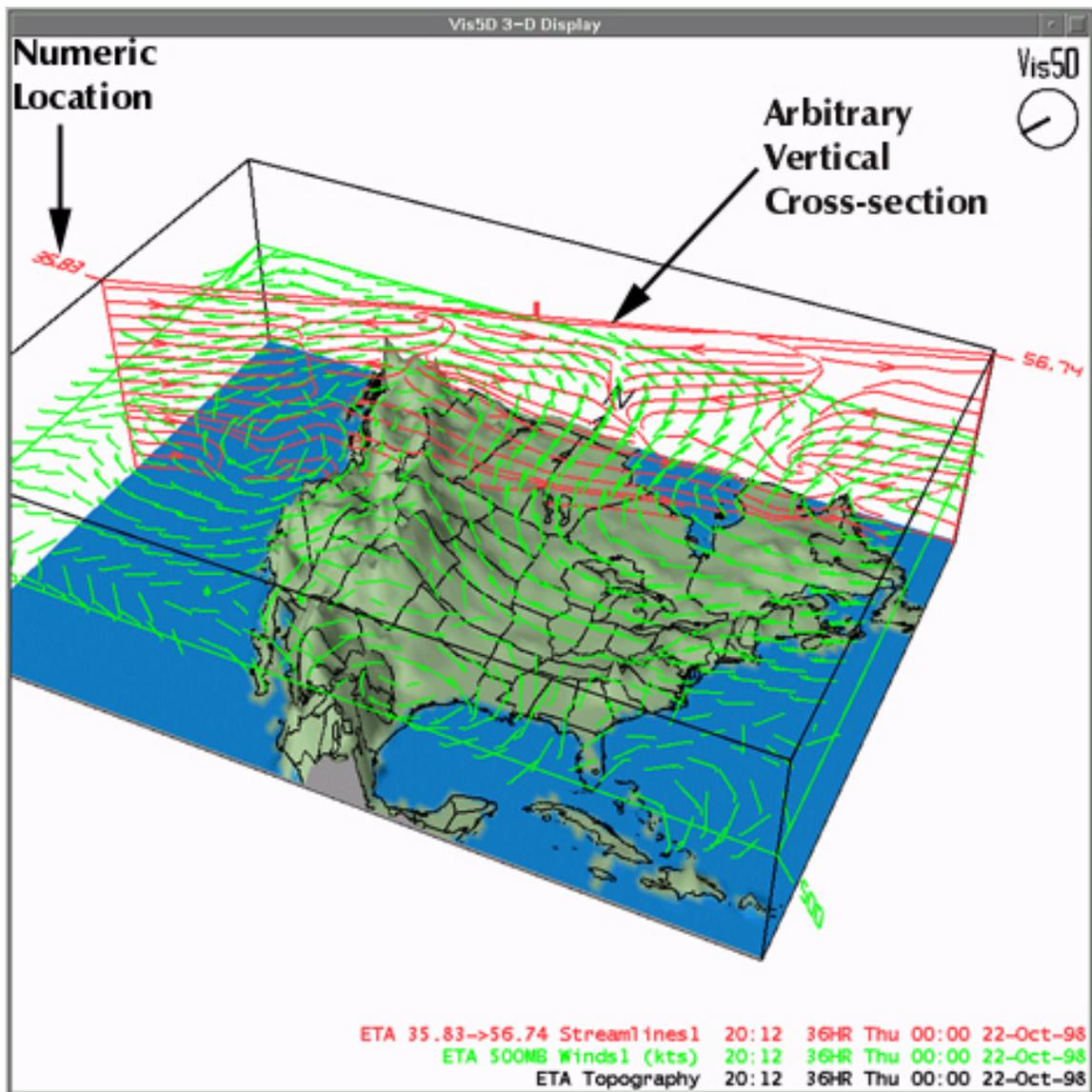


Figure 48. ETA 500MB Wind with an ETA Vertical Streamline cross section moved arbitrarily in a sweeping motion. The new cross section location indicated by numeric labels.

•Property Editor

The Winds Property Editor, as shown in Figure 49, has several options.

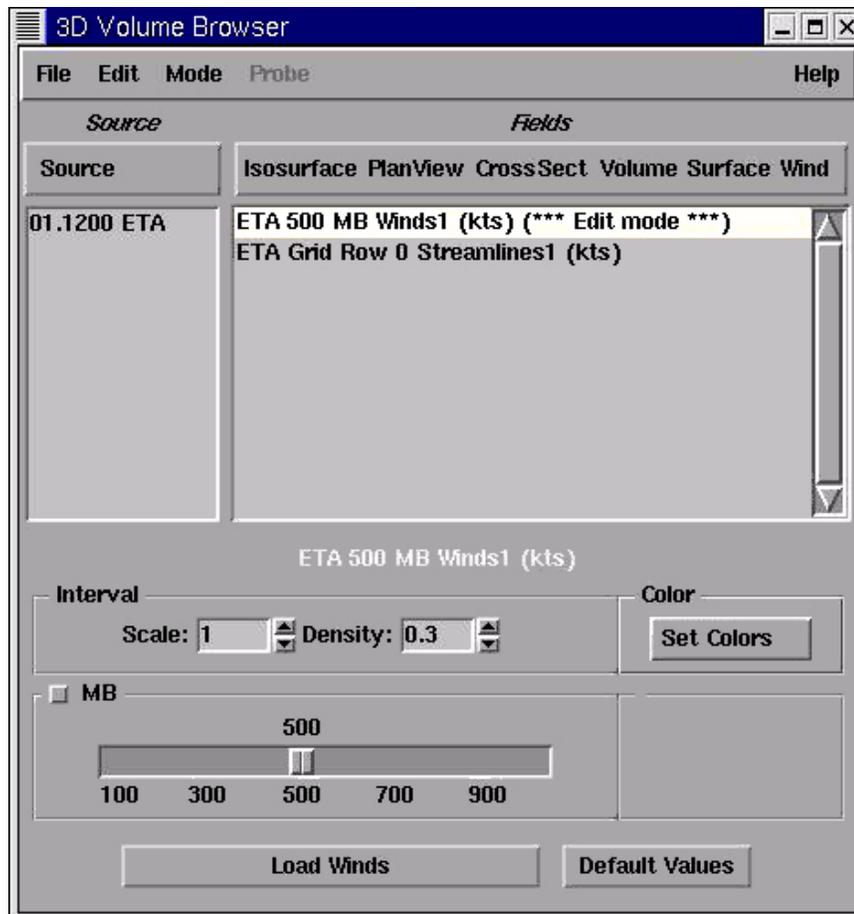


Figure 49. The Volume Browser - Winds Property Editor.

Interval

The **Scale** value applies only to wind barbs. It is used to multiply the length of vectors. If you want to double the length of all vectors, enter 2.0. If you want to halve the lengths, enter 0.5.

The **Density** value controls how many wind barbs and streamlines are displayed. In the case of wind barbs the value can only be between zero and one.

To make one-half the number of vectors, enter 0.5, for one-fourth enter 0.25, etc. The default value for both is 1.0.

In the case of streamlines the value can only be between 0.5 and 2.0.

To make one-half the number of streamlines, enter 0.5, to make twice the

number of streamlines, enter 2.0, etc. The default density is 1.0.

To change **Scale** and **Density** values, either use the small arrow buttons to increase/decrease the value, or type in a value then press Return using your keyboard.

Slider

The initial position for the cross section is the middle of the box that surrounds the data set.

The exact cross section location is given by a small numeric label near the corner of the cross section (see Figure 48).

To change the value, move the **slider**. Changes to the slider do *not* automatically generate a new slice for all time steps.

The position of the cross section can be changed interactively in the Large Display Pane using the mouse (see Figure 48). To do so you must first be in **Slice** mode by selecting the **Slice** from the **Mode Pull-Down Menu**.

For horizontal winds: To change from displaying Winds at pressure (mb) levels (the default) to displaying them at the surface, select the button closest to **MB**.

For vertical winds: To change between grid rows and grid columns, select the button closest to **Grid**.

Color

To change the color of the contours, press the **Set Colors** Popup Menu and choose one of the nine colors from the popup menu.

If you want more color selection information refer to the Color Subsection, described under Property Editor in Subsection 2.3.1.4, “The Property Editor.”

Load Winds

Press **Load Winds** to generate a winds for all time steps after changes have been made.

2.4 Other 3D Rendering Techniques

2.4.1 Sampling Techniques

Techniques for sampling data are explained in the following subsections.

2.4.1.1 Sounding

•Description

A Skew-T Diagram is generated for gridded data at the location of a vertical cursor. When you select the **Sounding** viewing mode from the **Mode**, a vertical sounding pop-up window appears on the screen and a vertical line cursor appears in the Large Display Pane that runs from the bottom to the top of the 3D Box. The sounding's location can be selected and moved interactively using Mouse Button 3 or the *Put 3D Cursor* menu option found in the Tools Pull-Down Menu on the Menu Bar. Refer to Figures 50 and 51 for a sample Skew-T plot and sounding.

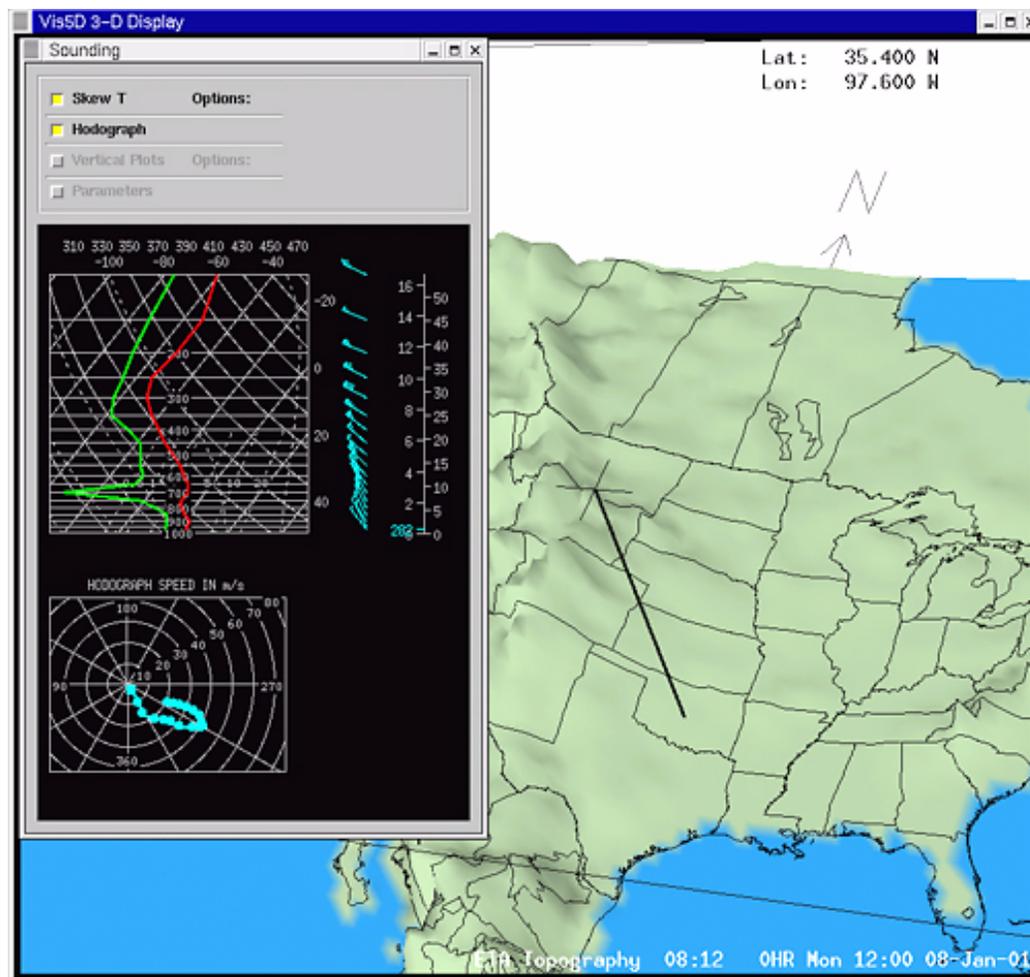


Figure 50. ETA Skew-T Plot and Sounding Located over Oklahoma City.

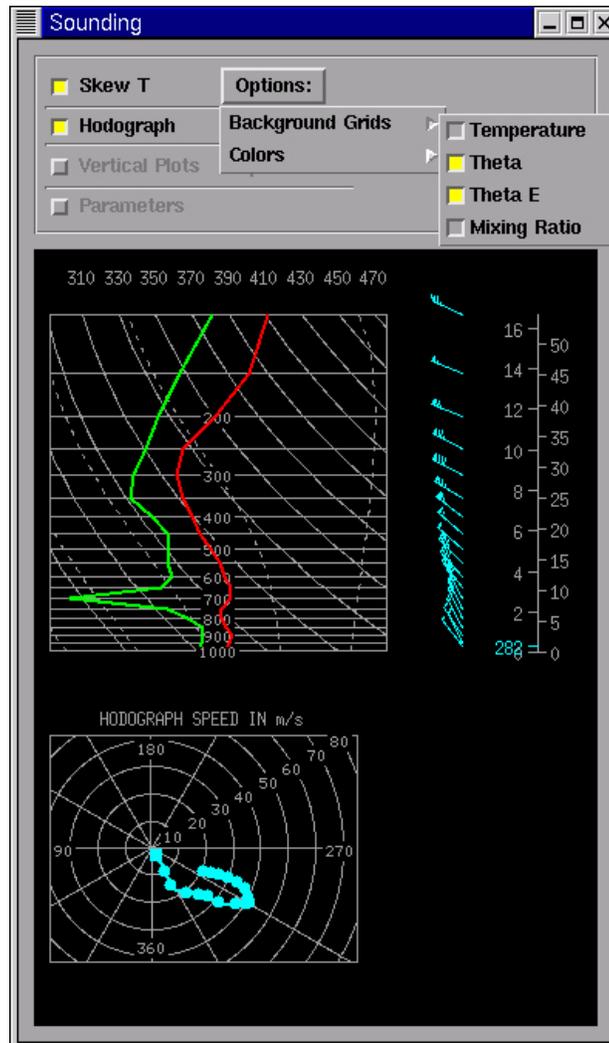


Figure 51. Skew-T Options Pulldown Menu.

You can control the background of the Skew-T Diagram, including dry adiabats, moist adiabats, constant mixing ratio lines and height tick marks by selecting/deselecting the appropriate buttons found under the Skew-T Options Menu. The fields, Temp, Dewpt, U, and V are used by default for the Skew-T.

Future enhancements to the sounding will be the ability to plot user-selected parameters, sampled in the vertical column, and the display of derived parameters (e.g. helicity), like those offered by D2D.

You can interactively resize and reposition the sounding window, but on some Linux systems this may delay system response for a moment while the X server locates the new position.

2.4.1.2 Probe

•Description

It is useful to inspect data values at various locations in the 3D volume. You do this with the probe. Select Probe from the viewing Mode Menu on the Volume Browser Menu Bar. A 3D Cursor appears in the 3D Box. You can move around using Mouse Button 3. The value of each field for the current time step is printed along the left edge of the Large Display Pane.

If you toggle the Grid Number option found in Display Options, the probe is constrained to integral grid coordinates. That is, the cursor 'snaps' to the nearest grid coordinate. Refer to Figure 52 for an example of the probe output and the Probe Pull-Down Menu.

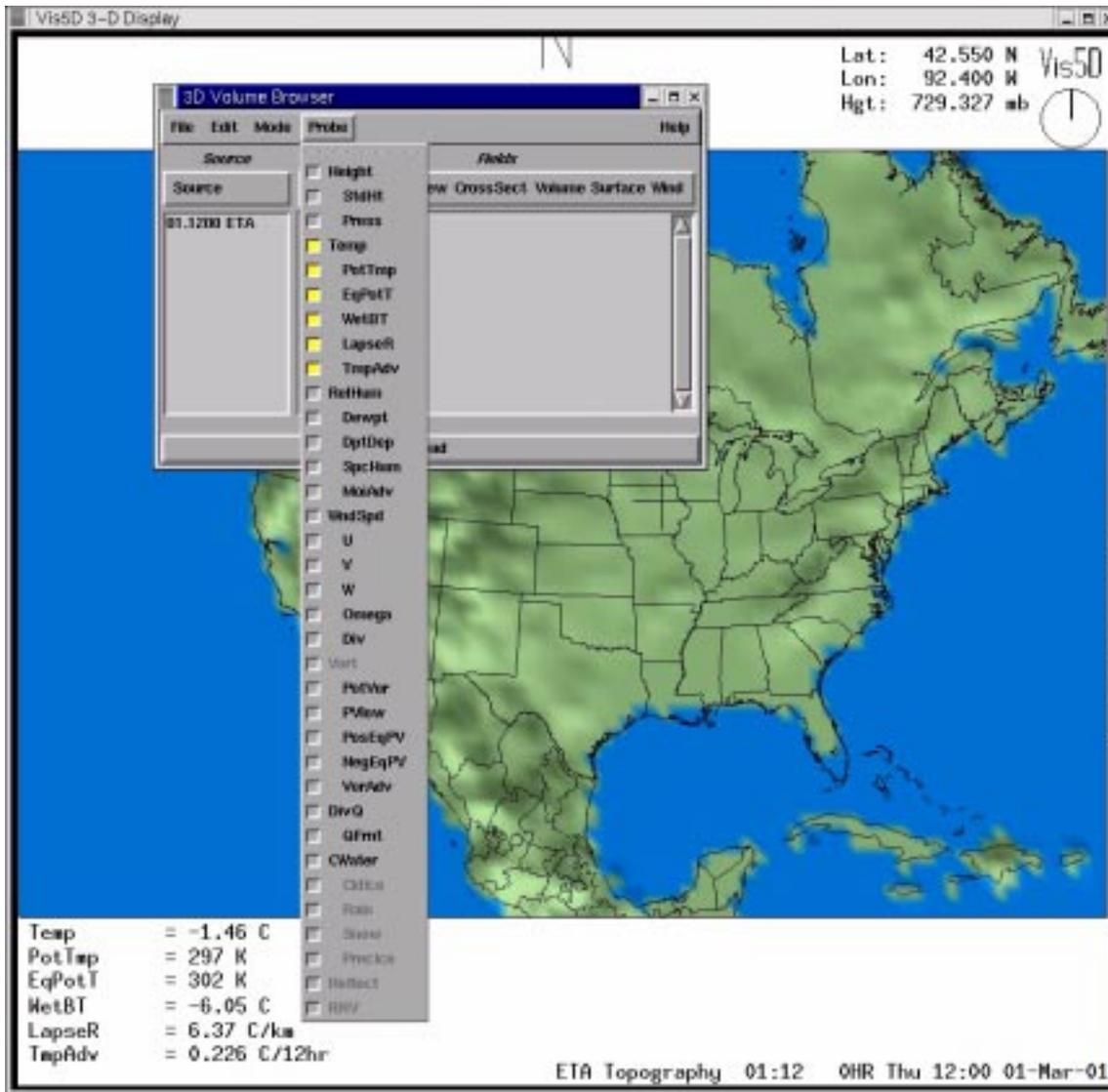


Figure 52. Probe Output of ETA Temperature Fields and Volume Browser - Probe Pull-Down Menu.

2.4.2 Trajectories

Wind trajectories are ribbons that trace the motion of air through the 3D volume, much like smoke trails trace the motion of air in a wind tunnel.

When you select *Trajectory* from the viewing **Mode** Menu on the Volume Browser Menu Bar, a pop-up dialog box appears near the bottom of the screen and a 3D Cursor appears inside the 3D View Box. The 3D Cursor is moved using Mouse Button 3 to specify where a new wind trajectory should be made.

The selected forecast hour is important because when the trajectory is made, it is traced forward from the current time step to the last time step and is traced backward through time to the first time step.

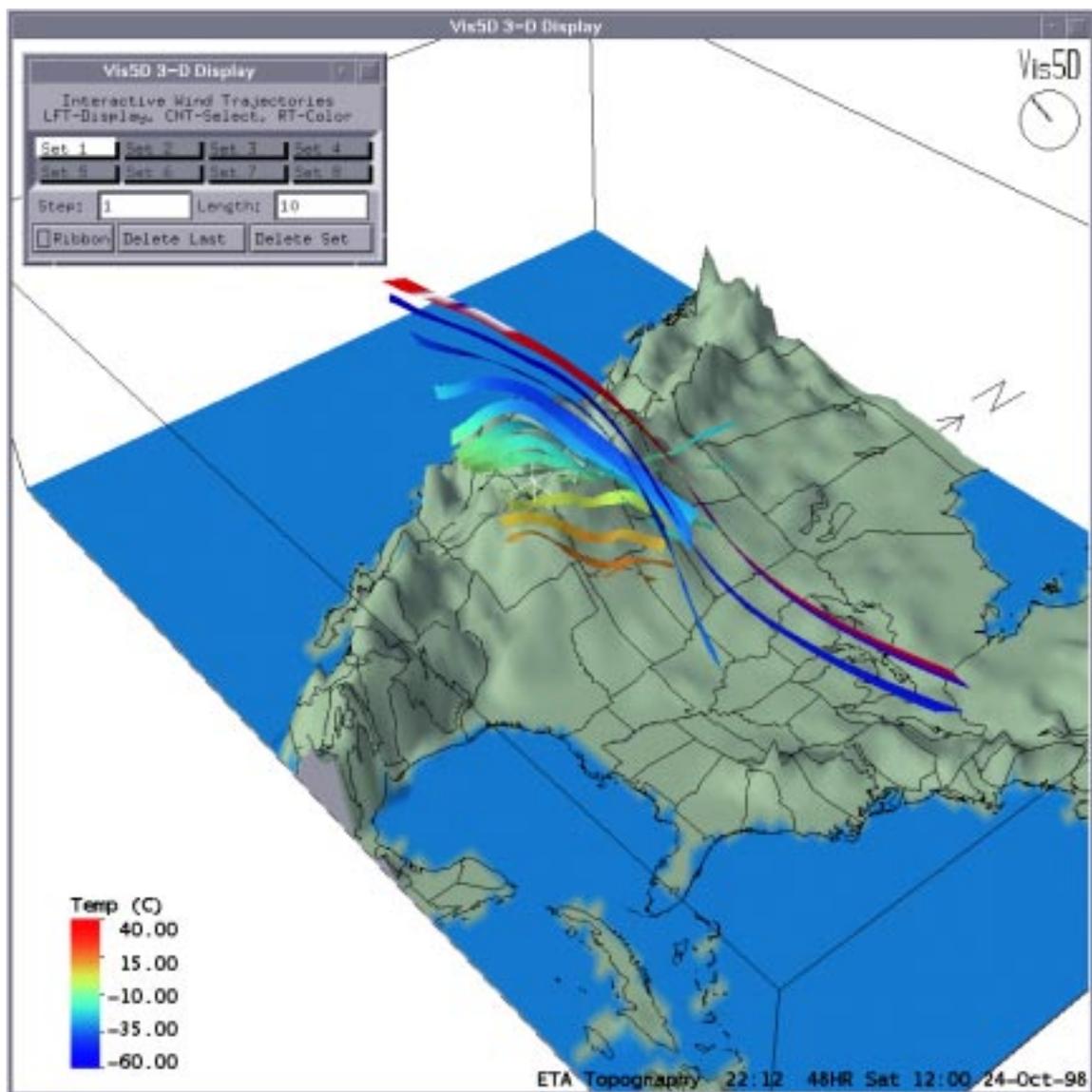


Figure 53. ETA Column of Trajectories Colored by Temperature.

Wind trajectories are dealt with in sets. Currently, eight sets are available. Each set is represented in the Trajectory Dialog Box with a button labeled Set1, Set2,..., Set8, see the inset in Figure 53. Each set can be individually displayed, colored, or deleted. As you create new trajectories you may want to group them in sets corresponding to location, time, etc.

The first step in creating a trajectory is to select a position with the 3D Cursor. Use Mouse Button 3 to drag the 3D Cursor around inside the 3D Box. The 3D Cursor moves in 2-D in a plane parallel to the plane of projection. That is, the cursor stays at a constant distance of depth. By alternately rotating the view box with Mouse Button 1 and placing the cursor with Mouse Button 3, the 3D Cursor can be placed anywhere inside the view box. The North, South, East, and West, and Top Buttons on the Menu Bar, as explained in Subsection 5.2, can also be useful when making trajectories.

Second, you should select a time step to begin the trajectory with the VCR Buttons on the Menu Bar. When the trajectory is made, it is traced forward from the current time step to the last time step and is traced backward through time to the first time step.

Finally, to make a trajectory at the current cursor location and current time step, press Mouse Button 2 when pointing inside the Large Display Pane. The trajectory appears as a line segment. By turning looping on, you can observe how the trajectory travels through time and space. Typically, you repeat the process of positioning the 3D Cursor and clicking Mouse Button 2 to create a set of trajectories.

Interesting results can be seen by making a trajectory when looping is turned on: a trajectory is created for every time step instead of just one. This shows you the path of every air parcel which passes through a single point in space.

Here is a summary of the trajectory functions.

1. To position the 3D Cursor, use a combination of rotating the view box with Mouse Button 1 and dragging the 3D Cursor with Mouse Button 3.
2. Use the VCR Buttons or looping option to select a time step.
3. Press Mouse Button 2 to create a trajectory at the current cursor location and time step.
4. To toggle the display of a trajectory set on or off, click on the Set Button with Mouse Button 1.
5. Select the current trajectory set by clicking on the Set Button with Mouse Button 2.
6. A trajectory set may be deleted with the Delete Set Button in the Trajectories Dialog Box. You are asked to verify your decision.
7. You can delete the last trajectory made by clicking on the Delete Last Button in the Trajectories Dialog Box.

Wind trajectories can be depicted in two ways: as line segments or as ribbons. You can select ribbons by clicking on the RIBBON Button in the Trajectory Dialog Box. Toggling the RIBBON

Button does not effect trajectories you have already made; it only controls how new trajectories are displayed.

The Trajectory Dialog Box also contains two type-in widgets labeled STEP and LENGTH. The STEP value is used to control the step size used in the trajectory tracing algorithm. The LENGTH value is used to control the length of trajectories. 1.0 is the default value for each. Each acts as a multiplier. If you want the trajectory tracer to integrate in steps 1/2 the default size, enter a step value of 0.5. If you want trajectories to be twice as long as the default length, enter a length value of 2.0.

The color of trajectories is controlled in the same way as for isosurfaces. That is, a trajectory set may either be monocolored or colored according to another field. Click on the Trajectory Set Button with Mouse Button 3 to bring up its color window. See the Color Subsection, under Property Editor in Subsection 2.3.1.4, “The Property Editor” for details on using the color window.

When viewing color-mapped trajectories be aware that the color of a trajectory is time dependent. Only the head of the trajectory is colored according to the value of another field for the current time step. The tail of the trajectory is colored according to the color of the other field when the head was at that location.

3. Working with Graphic Products

3.1 Product Legends

3.1.1 Toggle Product(s)

To toggle graphics in the Large Display Pane, you can click the pointer on the product legend.

3.1.2 Linking Cross Sections

Cross sections of the same orthogonal type (e.g. cross sections of a horizontal temperature image, horizontal humidity contours, and horizontal wind barbs) can be linked together. The purpose of linked cross sections is the ability to move cross sections in unison when sampling data.

To link two or more cross sections together, press and hold down the Shift Key, on your keyboard while you click the pointer on the desired product legends. Patiently wait to observe a “+” symbol attach to the product legend description (indicating the cross section is successfully linked) before clicking on another product legend. The Shift Key *needs* to be held down during the entire linking process. To unlink the cross sections again press and hold down the Shift Key while you click the pointer on the product legend you want to unlink.

3.1.3 Missing Data

A “~” symbol attached to the product legend description indicates that the product is missing data at all pressure levels for that time step.

3.1.4 Hiding All Product Legends

Clicking anywhere in the Large Display Pane with Mouse Button 3 toggles (on or off) the legends for all displayed products. Only the date and valid time labels remain.

3.2 Practice Modules on the Volume Browser

Subsection 2.3.1 introduced the Volume Browser Dialog Box's layout and menus. The following modules show you how to operate the Volume Browser using increasingly complex examples. You should have reviewed Subsection 2.3.1 before using these modules.

3.2.1 Module 1: Display Model Data as Isosurfaces

This module contains step-by-step instructions on how to load and display model data as iso-surfaces using the Volume Browser. Module 1 recreates the scene in Figure 38, Subsection 2.3.2, “The Volume Browser - Rendering Techniques,” using current data.

3.2.1.1 Objective 1 - Display Model Data as an Isosurface

This objective illustrates how to load an isosurface object.

•Steps

1. From the **View** Menu in the Menu Bar, select **Clear All**.
2. From the **Scale** Option Menu in the Toolbar, select **CONUS**.
3. From the **Volume** Menu in Menu Bar, select **Browser**.
4. From the Volume Browser's **Source** Menu, load the **ETA** Model by selecting it from the list.
5. Under **Fields**, open the **Isosurface** Pull-Down Menu and select **Wnd-Spd**.
6. Move the pointer over the product name that appears in the Volume Browser's Product List and click Mouse Button 3 (Right). The **Wind Speed Isosurface** Property Editor should now be opened.
7. Using Mouse Button 1 move the slider value to **95** kts.
8. Again move the pointer over the product name in the Product List and again click Mouse Button 3. This closes the Property Editor for **Wnd-Spd**.
9. Press **Load**.
10. Continue to display this product for Objective 2.

3.2.1.2 Objective 2 - Working with Graphics in the Large Display Pane

•Steps

1. From Objective 1, the **ETA 95 kts Wind Speed Isosurface** Field should be displayed in the Large Display Pane on the CONUS Scale.
2. Place the pointer in the direct center of the Large Display Pane.
3. Press and hold Mouse Button 1 (Left) and slowly move the pointer two inches toward the top of the screen. Release the button. You should see the 3D objects rotate slightly to the north.
4. Press and hold Mouse Button 2 (Middle) and slowly move the pointer two inches toward the top of the screen. Release the button. You should see the 3D objects become larger. This is the scaling/zooming function.

5. Press and hold Mouse Button 3 (Right) and slowly move the pointer two inches to the left. Release the button.

You should see the 3D objects move to the west. This is the translation function.

6. From the **View** Menu in the Menu Bar, select **Default** to reset to the default top view and reset the scale. Or, press Top View (**T** directional arrow) from the Toolbar to reset to the default *without* changing the zoom factor.
7. Again rotate the 3D objects north (Step 3).
8. Press the **Toggle Perspective** Button from the Toolbar to toggle a perspective viewing projection. This particular projection adds depth to the 3D Display.
9. Try looping and stepping the displayed objects from buttons available on the Toolbar.
10. Turn looping off.
11. Continue to display this product for Objective 3.

3.2.1.3 Objective 3 - Display Multiple Model Graphics as Isosurfaces - I

•Steps

1. From Objective 2, the **ETA 95 kts Wind Speed Isosurface** Field should be displayed in the Large Display Pane on the CONUS Scale with a perspective view from the south looking north.
2. Under **Fields**, open the **Isosurface** Pull-Down Menu and select **SpcHum**.
3. Press **Load**.
4. Continue to display this product for Objective 4.

3.2.1.4 Objective 4 - Display Multiple Model Graphics as Isosurfaces - II

•Steps

1. From Objective 3, the **ETA 95 kts Wind Speed Isosurface** and **ETA 14 g/kg Specific Humidity** Fields should be displayed in the Large

- Display Pane on the **CONUS** Scale with a perspective view from the south looking north.
2. Under **Fields**, open the **Isosurface** Pull-Down Menu and select **PotTmp**.
 3. Move the pointer over the **PotTmp** product name that appears in the Product List and press Mouse Button 3.
 4. Using Mouse Button 1 move the slider to **285** kts.
 5. Select **Press(ure)** from the **Solid** Pull-Down Menu.
 6. Move the pointer over the product name in the Product List and again press Mouse Button 3. This closes the WndSpd Property Editor.
 7. Press **Load**.
 8. Continue to display this product for Objective 5.

3.2.1.5 Objective 5 - Changing Object Colors

•Steps

1. From Objective 5, the **ETA 95 kts Wind Speed Isosurface** Field, **ETA 14 g/kg Specific Humidity** Field and **ETA 285 K Potential Temperature** Field colored by Pressure should be displayed in the Large Display Pane on the **CONUS** Scale with a perspective view from the south looking north.
2. To color the Wind Speed Isosurface red, move the pointer over the WndSpd product name that appears in the Product List and press Mouse Button 3.
3. Select **Immediate mode** from the Property Editor.
4. Select the red colored bar from the **Set Colors** Popup Menu and the isosurface immediately appears in the new color.
5. To color the Specific Humidity yellow, move the pointer over the SpcHum product name and press Mouse Button 3. This replaces the **Wind Speed** Property Editor with the **Specific Humidity** Property Editor.
6. Select the yellow from the **Set Colors** Popup Menu and the isosurface immediately appears in the new color, that is, if **Immediate mode** is still selected.
7. From the **Options** Menu in the Menu Bar, select **Reverse B/W** from the **Display Options** Cascading Menu.

3.2.2 Module 2: Display Model Data as Plan-View

This module contains step-by-step instructions on how to load and display model data as plan-views using the Volume Browser. Module 2 recreates the scene from Figure 40, Subsection 2.3.2.2, “The Volume Browser - Rendering Techniques - Plan-View,” using current data.

3.2.2.1 Objective 1 - Display Model Data as Plan-View Contours

This objective illustrates how to load an plan-view object.

•Steps

1. From the **Toolbar**, select **Clear** to clear all products in the Large Display Pane except for the map background and topography.
2. From the **Scale** Option Menu in the Toolbar, select **CONUS**.
3. From the **Volume** Menu in Menu Bar, select **Browser**.
4. From the Volume Browser's **Source** Menu, load the **ETA** Model by selecting it from the list.
5. Under **Fields**, open the **Plan-View** Pull-Down Menu and select **Wnd-Spd**.
6. Press **Load**.
7. Rotate the 3D objects north. (Refer to Module 1, Objective 2, Step 3.)
8. Continue to display this product for Objective 2.

3.2.2.2 Objective 2 - Display Model Data as a Plan-View Image

•Steps

1. From Objective 1, display the **ETA 500 MB Wind Speed Plan-View** contours in the Large Display Pane on the **CONUS** Scale.
2. Open the **Wind Speed Plan-View** Property Editor. (Move the pointer over the **WndSpd** product name that appears in the Volume Browser's Product List and click Mouse Button 3).
3. Select **Image** from the **Type** option found on the **Property Editor**.
4. Press **Load Plan-View**.
5. Select the **Edit Colors** from the **Set Colors** Popup Menu.

6. Place the pointer on the editable color table that appears showing graphs of red, green, and blue over the range of data values.
7. Tap the Left Arrow Key on your keyboard to move the curves left until the colors show a better definition of values on the cross section visible in the Large Display Pane. The legend in the Large Display Pane reflects changes to the color table.
8. Close the Property Editor (move the pointer over the **WndSpd** product name that appears in the Volume Browser’s Product List and click Mouse Button 3).
9. Continue to display this product for Objective 3.

3.2.2.3 Objective 3 - Add a Map to Plan-View Cross Section

•Steps

1. From the **Map** Menu in the Menu Bar, select **Moveable Map**.
2. Using Mouse Button 1 move the slider value to **500** mb.

4. Other Topics

•Performance Dos and Don'ts

1. It may be advantageous to stop the animation (Loop) while rotating, scaling, or translating the 3D volume in the Large Display Pane.
2. Window managers have various methods for moving and resizing windows. Some performance degradation has been noted in D3D with certain methods, such as 'Opaque' and 'Transparent' movement methods (due to the way expose events are handled). The 'Box' method of moving and resizing windows is recommended. These can be changed by launching your window manager's configuration editor.

5. Applications

5.1 Variable Maker

From the Main Menu Bar's Volume Menu you can open the Variable Maker, which lets you create and generate products on demand from the gridded model data. Refer to Figure 54.

Figure 54. The Variable Maker.

The Variable Maker lets you type in mathematical formulas and expressions to compute new variables as a function of existing variables. For example, to compute wind speed from U, V, and W you would enter the formula:

$$\mathbf{SPD3D = SQRT (U*U + V*V + W*W)}$$

To compute the ratio of dew point (Dewpt) to temperature, you would enter the formula:

$$\mathbf{RATIO = Dewpt / Temp}$$

Formulas can use the names of existing variables, numbers, the arithmetic operation +, -, *, / and ** (exponentiation), and the functions SQRT, EXP, LOG, SIN, COS, TAN, ATAN (arc tangent), ABS, MIN, and MAX. MIN and MAX take two arguments, while the other functions all take one argument. Click on the OK Button to compute the new variable or Clear to discard the formula. Close window to exit.

5.1.1 Clearing the User-Defined Variable

To clear the variable(s) created using the Variable Maker select 'Clear user-defined fields' from the Edit Pull-Down Menu found on the Volume Browser. When new models are loaded user-defined fields are deleted.

6. Glossary

See the *WFO-Advanced D2D User's Guide* Section 10, “Glossary.”

Cascading Menu	A submenu that provides selections that amplify the parent selection on a pull-down menu or a popup menu.
Check Button	A graphic component that simulates the buttons on a radio. Each button represents a mutually exclusive selection. Check buttons are typically used for setting states or modes.
Click	To press and release a Mouse Button. The term comes from the fact that pressing and releasing most Mouse Buttons makes a clicking sound.
Close	A label given to a Push Button in some dialog boxes that performs the action of closing the dialog box. Close is also used as a selection in menus to close the window associated with the menu.
Cursor	A graphical image, usually a pipe (I) or block, that shows the location where text appears on the screen when keys on the keyboard are pressed or where a selection can be made.
Desktop	See “Workspace.”
Dialog Box	A secondary window that the user can display and that contains application components.
Dimmed Selection	A selection that is not currently available.
Double-Click	To press and release a Mouse Button twice in rapid succession.
Focus	A state of the system that indicates which component receives keyboard events. A component is said to have the focus if keyboard events are sent to that component.
Glyph	A symbol (as a curved arrow on a road sign) that conveys information nonverbally.
Help	A label given to a Push Button in some Menu Bars and dialog boxes that performs the action of providing help for the dialog box.
Highlight	A visual cue to the current selection or to the current location of the input focus.
Icon	A small graphical image used to represent a window or dialog box. Windows can be turned into icons or minimized to save room or unclutter the workspace (See “Workspace”).

Insertion Cursor	The graphical symbol that provides the visual cue to the location of the insertion point.
Keyboard	An input device consisting of various keys that allows the user to input data, control cursor and pointer locations, and to control the dialog with the workstation.
Keyboard Focus	Indicates the window or component within a window that receives keyboard input. It is sometimes called the “Input Focus.”
Label	The text part of an icon or graphical component.
Location Cursor	A graphical symbol that marks the current location of the keyboard input focus for selection. Typically, this symbol is a box that surrounds the current object.
Maximize	To enlarge a window to its maximum size.
Menu	A list of available selections from which a user chooses.
Menu System	A collection of menus.
Menu Window	An application window used to contain a menu. Menu windows are transitory.
Menu Bar	A rectangular area at the top of the client area of a window that contains the titles of the standard pull-down menus for that application.
Menu Bar System	A collection of menus associated with a Menu Bar and the Menu Bar itself.
Message Box	The generic name for any dialog box that provides information, gives the current state of a work in progress, asks a question, issues a warning, or draws attention to an error.
Minimize (Iconify)	To turn a window into an icon.
Mouse	A pointing device commonly used in conjunction with a keyboard in point and click object-oriented user interfaces.
Mouse Button	A button on a mouse pointing device. Mouse Buttons can be pressed, released, moved, clicked, and double-clicked.
Multiclick	To click a Mouse Button multiple times without moving the pointer.
Open	To start an action or begin working with a text, data, or graphics file.

Pointer	The graphical image that appears on the workspace and represents the current location of a mouse or other pointing device. Also referred to as “Mouse Pointer.”
Pointing Device	A device such as a mouse, trackball, or graphics tablet that allows users to move a pointer about on the workspace and point to graphical objects.
Popup Menu	A menu that provides no visual cue to its presence, but simply pops up when a user performs a particular action. Popup menus are associated with a particular area of the workspace, such as the client area of an application, and a user must memorize where these areas are.
Press	To hold down a Mouse Button or a key.
Pull-Down Menu	A menu that is pulled down from a client application’s Title Bar.
Push Button	A graphic component that simulates a real-life push button. When a user pushes the Push Button, by pressing a key or a Mouse Button, an action takes place.
Release	To let up on a Mouse Button or key that has been pressed. Sometimes it is the press that initiates the action; sometimes it is the release.
Resize	To change the height or width of a window.
Restore	To return an icon or maximized window to its normal size.
Save	To write changes to a data file to a storage device for safe-keeping.
Scroll Bar	A graphical device used to change a user’s view of the contents of a window. A scroll bar consists of a slider, a trough, and scroll arrows. A user changes the view by sliding the slider up or down in the scroll area or by pressing one of the scroll arrows. These actions cause the view to scroll up or down in the window adjacent to the scroll bar.
Secondary Window	A child window of a primary window.
Select	To choose an object to be acted upon or an action to be performed.
Selection	The object or action that is selected. Menus are composed of selection items. Dialog boxes contain components, each of which represents a selection.
Single Selection	A selection model that allows selection of a single element.

Slider	One of the graphical components of a scroll bar or scale. The slider is the object that is dragged along the scroll area to cause a change.
Submenu	A “Cascading Menu.”
System Menu	See “Window Menu.”
Tear-Away Menu	A menu that can be moved around the workstation screen, away from the location on the screen where it first opened, by grabbing it in the Title Area and repositioning it on the screen.
Text Cursor	See “Insertion Cursor.”
Title Area	The area at the top of the window frame immediately beneath the resize border. The title has two functions: it contains a title or name that identifies the window, and it can be grabbed and dragged to relocate the window.
Title Bar	The bar across the top of a window manager window that consists of the Window Menu Button, the Title Area, and the Window Control Buttons.
Window	A data structure that represents all or part of the display screen. Visually, a window is represented as a sub-area of the display screen.
Window Frame	The area surrounding a window. A window frame can consist of a resize border, a Window Menu Button, a Title Bar, and Window Control Buttons.
Window Menu	The menu that appears when the Window Menu Button is pressed. The Window Menu typically contains selections for restoring, moving, sizing, minimizing, maximizing, and closing the window.
Window Menu Button	The Graphical Control Button that appears at the left side of the Title Bar in the window frame.
Workspace	The CRT screen - the area on which the windows of a user’s environment appear. The workspace is sometimes called the desk, desktop, or root window.

7. Supplemental Information

Regarding other issues and concerns, please document them and contact the D3D System Development Team.

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